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The gas works of Philadelphia are owned and operated by the city. Attempts have been repeatedly made by syndicates of capitalists to purchase the works, but an overwhelming public sentiment has always asserted itself to prevent such a sale. Recently a new attempt has been made to purchase the works, and at the first session of the newly elected city council on April 5 the following resolution was adopted by a unanimous vote:

Resolved, That it is the judgment of the common council of the city of Philadelphia that the gas works of the city should not be sold, and we hereby express our disapproval of the alleged efforts now being made in that direction.

A resolution was introduced at the same time and referred to a committee that legislation should be secured for enlarging and improving the city's plant, so that better gas can be furnished to consumers at $1 per M. with no loss to the city.

Meterological observations at Cornell University have afforded a very large amount of data during the past 20 years upon the relative amount of rainfall during short periods; in fact, the college has a complete and continuous record during the past 10 years perhaps for every minute of the day. Also studies are being made upon the rate of rainflow from given water sheds, due to the various conditions of the surface; and systematic observations upon the amount of evaporation under normal conditions of the evaporation gages or machines. Some interesting studies are under way by means of which there can be recorded simultaneously on four different sheets of paper, the horizontal component of the wind, its vertical component, its direction, and, when the velocity exceeds 15 to 20 miles per hour, another machine is thrown into an electrical circuit, so that every half revolution of an exceedingly delicate anemometer is recorded. This last instrument bids fair to settle some old controversies, for with ordinary velocities, it often exhibits gusts of extraordinary intensity, as for example: 60 miles per hour have been recorded for a few seconds at a time, when the ordinary anemometers recording only each mile of the wind traveled only exhibited a total run of 20 miles per hour.

Artesian wells seem destined to play an important part in the development of the Dakotas, and in fact are already doing so. The report of Mr. C. S. Fassett, State Engineer of Irrigation for South Dakota, for the year 1893-4 states that during the year 23 wells were completed within the state, while nine more were, at the time of the report, either under construction or contract, and ten were projected for early construction. These wells, it appears, are being sunk under a state law providing for county action in this line, upon vote of the people and previous approval by the state engineer. Mr. Fassett's report was published in the Pierre "Journal" for Feb. 15, 1894, and contains considerable information regarding both artesian wells and irrigation.

The corrosion of water and gas pipes by the return currents of electric street railways has been frequently described in these columns and it is now claimed that fire risks are also increased by the same agency. In a recent number of the Boston "Herald," Mr. H. C. Cushing, Jr., an electrical inspector for the Boston Board of Fire Underwriters, cites several instances where electrical currents of considerable strength have been carried into buildings through gas or water pipes, and this has sometimes occurred when large differences of voltage were present, with corresponding dangers of fire under favorable circumstances. Mr. Cushing states that in the basement of one building a man had obtained a current of 25 amperes at eight volts by simply twisting his wires around two different water pipes which entered the building. The only way to eliminate these dangers, says Mr. Cushing, is to provide complete metallic circuits for all strong electrical currents.

The British Board of Trade report on railway and canal rates shows that in four years, ending with 1893, 248 complaints were received and acted on, of which 83 were settled more or less to the satisfaction of the complainants, 76 without such satisfaction, 68 were dropped and 21 are still under consideration. The report gives the action in detail on the 75 cases acted on during the past year with admirable clearness and conciseness. The powers of the board are advisory only, but in most cases are decisive of the controversy.

Injuries to British railway employees for the past 20 years, as summarized in a recent Board of Trade publication, are shown in the table below. In examining it, it is to be remembered that only the deaths give an approximately fair comparison for the years reported, since the increasing accuracy with which minor injuries are reported tends to increase their apparent number. It is also to be remembered that the injuries to passengers have decreased during this period in much greater ratio than the injuries to employees, and that the volume of traffic has approximately doubled in this period.

Year.	No. of employees.	Killed, No.	Injured, No.	Killed, 1 in	Injured, 1 in
1873	274,585.....	773	1,171	355	234
1874	"	642	2,163	427	126
1880	"	546	2,080	502	131
1881	"	521	2,446	526	112
1882	"	553	2,576	496	106
1883	367,793.....	554	2,460	663	149
1884	"	546	2,319	673	158
1885	"	451	2,117	815	173
1886	"	425	2,010	865	182
1887	"	422	2,075	871	177
1888	"	396	2,193	928	167
1889	381,626.....	435	2,769	877	137
1890	"	499	3,122	764	122
1891	"	549	3,162	695	120
1892	"	534	2,915	714	130

The most serious railway accident of the week was the derailment of a westbound passenger train at Lake Benton, Minn., on the Chicago & Northwestern Ry., April 6, in which one man was killed.

A big slide has covered the tracks of the Coeur d'Alene branch of the Northern Pacific R. R., near the Black Bear mine, for a length of 1,000 ft. The slide is composed of snow, earth rocks and timber and in some places is 100 ft. deep.

Some notes on the Chesapeake & Ohio Ry. were given in our issue of April 5 and we are indebted to Mr. H. Frazier, Chief Engineer, for the following additional items in regard to the through freight route from the West, etc. The main passenger line extends from Washington to Cincinnati, making connection at Gordonsville for Richmond, Newport News and Old Point Comfort. From Clifton Forge to Richmond the freight is brought by the James River Division, a low-grade road, having no adverse grades for east-bound traffic. The line west of Clifton Forge, over the Allegheny Mountains, has a very low grade, and is largely double tracked as far as Hinton. This track is blocked from interlocking towers. It is noticeable that this company has adopted purple lenses for secondary routes at all its interlocking plants, using red and white only for the high-speed routes. The pit cattleguards are being replaced by metal surface guards, and the low trestles through swampy ground are being replaced with permanent structures.

The Bushe rapid transit scheme now before the Rapid Transit Commission of New York city provides for a considerable extension of the city's present mileage of elevated railways. According to the plan two main lines are to start from the Battery, one going up West St., West 11th St. and Seventh Ave., to Broadway, and thence to the city line; the other going up South St., James St., Center St. and Fourth Ave. to the Grand Central station at 42d St. These lines are connected by a line from Center St. along Canal St., Wooster St., University Place and 14th St. to Seventh Ave., while a crosstown line runs from West St. along Vestry St., Spring St., between Delancey and Rivington Sts. and along Columbia St., to the terminus of the proposed new East River Bridge at Jackson St. There is also a short branch on Center St. to City Hall Park. It is currently reported that two members of the commission are opposed to the scheme and will at least withhold their approval until the fate of the rapid transit bills now pending in the New York legislature is decided.

The district drainage law of Indiana has been decided to be unconstitutional by Judge Wiley, of the Thirteenth Judicial Circuit. This law was passed in 1893, and is similar to the Illinois law. The case in which decision was rendered was the application of the law in the drainage of a 20,000-acre ranch. It was under this law that it was expected to drain the Kankakee River marshes, involving 500,000 acres of land. The decision will render invalid all proceedings commenced under the law.

The Missouri River bridge at Alton, Ill., has been completed by the Chicago, Burlington & Quincy R. R., and the first train crossed April 3. The formal opening will be on May 1.

Garbage crematories are to be established at Atlanta, Ga., by the Dixon Crematory Co. The city can use them for a year, and at the end of that time has the option of accepting or rejecting them. The board of health has had this system of garbage disposal under consideration for some time.

The River and Harbor bill, in its present shape, calls for an appropriation of about $9,500,000, while the Sundry Civil bill contains items aggregating $8,500,000 for contract work on rivers and harbors.

The New Jersey Forestry bill passed by one house of the New Jersey legislature provides for the establishment of a state forest reserve, and a system of forestry management and supervision.

The new light at the Minot's Ledge lighthouse on Boston Bay will be the first one of the Mehan system in this country, and will flash its number (143) at intervals of 30 seconds. The system was invented by M. Mehan, of France, and has been in use for some time in that country.

The whaleback type of steamship has been reported by a naval board as unsuited for auxiliary cruisers when mounted with armament on account of the small freeboard presented and the inability to carry the weight of heavy guns. The board was designated by the Secretary of the Navy some weeks ago to investigate proposals submitted by a Western shipbuilder, and after experiments and calculations of weights finds that only the very lightest rapid-fire guns could be mounted on the decks. Auxiliary cruisers to be efficient as commerce destroyers would have to be armed with heavy guns, and are useless with only a battery of light rapid-fire ordnance. The board is said to have discovered that almost any whaleback would stand on its stem with an 8-in. gun mounted forward, and that the whalebacks have too little deck room to properly work heavy ordnance.

Extensive harbor works are projected at Everett, Wash. The Everett Land Co. proposes to dredge an area some 3,500 ft. in length and 1,500 ft. in depth, to a depth sufficient for ocean vessels, and to inclose the area by bulkheads with locks and tide-gates. The project has been approved by the engineers of the War Department. Mr. Schuyler Duryee, of Everett, Wash., is Vice-President of the Everett Land Co.

The proceedings of the city of Brooklyn, N. Y., to condemn the property of the Long Island Water Supply Co. have been stayed by an order from the Supreme Court, pending appeal to the Court of Appeals from the award of the commissioners of appraisal.

The armor plate and armament item of the naval appropriation bill has been cut down $2,000,000 by the House Committee on Naval Affairs, making the amount of the appropriation $4,500,000. The Navy Department estimate was $6,500,000. This was to wind up large outstanding contracts with the Carnegie and Bethlehem companies for armor for the new war vessels.

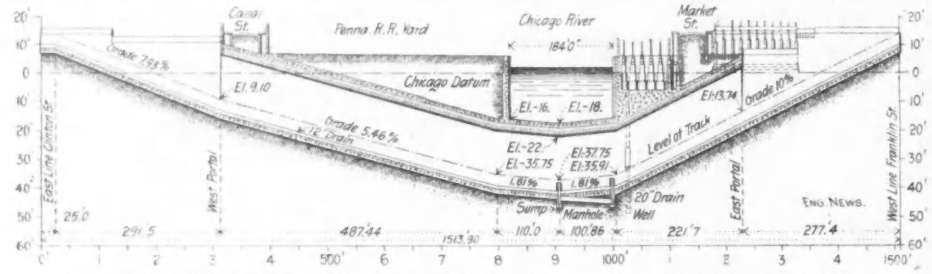
Underground electric wires for Boston are proposed by the bill introduced by Mr. Hoar in the Massachusetts legislature. It provides that the city engineer, the superintendent of wires and the inspector of wires of the city shall constitute the board of commissioners of electrical wires, of which the city engineer shall be chairman. This board shall annually, in the month of January, prescribe the streets within which all electrical wires, cables and conductors, including railway feed and return wires, except trolley, guard and span wires, shall be during the calendar year removed or placed under ground. The streets, however, for each year shall not comprise more than one-fourth or less than one-sixth of a certain territory defined in the bill.

CONSTRUCTION OF WEST CHICAGO CABLE RY. TUNNEL UNDER CHICAGO RIVER.

(With inset.)

The large street railway tunnel under the South Branch of the Chicago River, near Van Buren St., Chicago, which has been under construction for about four years, is now practically completed and will soon be opened for traffic. This tunnel, while only 1,576 ft. long and constructed practically in open cut its entire length, has proved an unusually difficult and expensive undertaking owing to the peculiar conditions under which the work had to be prosecuted. The section of the tunnel was, in the first place, unusually large and the material penetrated very unfavorable, being for the most part a soft plastic clay having a natural slope of about 3 to 1. Again, the tunnel passed underneath the foundations of several large buildings and but a short distance underneath the tracks of the Pittsburg, Ft. Wayne & Chicago R. R. on the west bank of the river, all of which had to be either rebuilt or temporarily supported without seriously disturbing business. To this is to be added frequent and often long interruptions of the work by litigation, which required it to be done in sections often remote from each other, which had to be connected whenever circumstances would permit. Some of the methods adopted to overcome these difficulties of construction are shown on our inset sheet this week.

In our issue of Feb. 22, 1890, we illustrated the profile and sections of this tunnel as then proposed. At that time work had just been commenced, and the various conditions which afterward compelled a modification of the original plans had not been encountered. Such changes as had to be made, however, were largely changes in the profile of the tunnel and the manner of rebuilding the foundations



GENERAL PROFILE OF VAN BUREN ST. TUNNEL, WEST CHICAGO STREET RY.

of buildings, no changes being made in the shape or dimensions of the section or in the character and quality of the masonry.

In Fig. 1 is shown the revised profile of the tunnel as constructed. The form of the tunnel section can be seen from any of the sections in the accompanying cuts. This section required an excavation over 41 ft. wide for the masonry. The arch masonry consists of seven rings of brick resting on stone footing courses, and the invert is of concrete. For a distance of 250 ft. each way from the center of the river the two outer rings of brick are laid in asphalt mastic mortar, with very thin joints. The same mortar was used in laying the outer ring of brick for the entire length of the tunnel. The other rings of brick are laid in Utica natural cement mortar, 8,000 bbls. being used, and the concrete is composed of 1 part Portland cement, 3 parts sand and 6 parts broken stone. About 21,000 bbls. of Portland cement were used in making concrete.

With the above brief statement of the general features of the work the details of construction illustrated herewith will be easily understood. Briefly stated, these include the details of the new foundations for two buildings at the east end of the tunnel, the cofferdam construction in the river and the construction under the railway tracks on the west bank of the river.

Referring to our inset sheet, Fig. 2 shows a vertical longitudinal section of the tunnel approach and of the six-story building at 233-5 Market St., and the seven-story building at 234-6 Market St., beneath which the tunnel passes. Figs. 3 and 4 show transverse sections of the tunnel and these buildings taken at various points. It was originally intended to sink cast iron cylinders below the bottom of the tunnel, fill them with concrete and support the side walls of these buildings on arches turned between the cylinders. The interior columns and walls were to be carried on temporary trusses during the construction and supported by piers resting on the tunnel masonry when completed. It was, however, considered advisable after beginning construction to tear down and rebuild a portion of the buildings directly over the tunnel as on the whole less troublesome and dangerous. Such walls as it was necessary to leave standing were therefore supported on jacks, the others torn down, the excavation made and the masonry completed. The building was then rebuilt, the side walls being supported on pile foundations and the interior columns on piers resting on the completed arch masonry, as shown in the illustrations.

In the building at 233-5 Market St., which extends out over the open approach, a heavy fireproof floor of steel girders and brick arches was built, strong enough to carry fallen ironwork and other debris and leave the tunnel unblocked in case of a fire. Aside from this flooring the design and construction of the foundations of the two buildings are practically the same. The engines, dynamos, pumps, etc., for lighting and draining the tunnel and supplying power and heat to both buildings are located in the basement of 234-6 Market St.

In constructing the section of the tunnel under the river a cofferdam was first built out from the west shore to the middle of the channel and the tunnel masonry was constructed in open cut, as shown in Fig. 5. When the masonry had been completed to the mid-channel wall of the cofferdam a crib dam to form the channel wall of the second cofferdam was built, as shown in Fig. 6. The side walls of the first cofferdam were then torn away and rebuilt as side walls for a second cofferdam extending out from the opposite shore. The second half of the tunnel masonry under the river was then built like the first half.

No serious difficulties were met with in the river work, but upon reaching the portion of the tunnel to be constructed under the interlocked yard tracks of the Pittsburg, Ft. Wayne & Chicago R. R., the problem of supporting the tracks without injury to the working of the switches or a delay to the traffic confronted the engineers.

The method adopted was as follows: Four parallel rows of piles were driven between the tracks, as shown in Fig. 7, and upon them was constructed a platform to carry the tracks. This portion of the work was very tedious as it was for only two or three hours of the day that the traffic permitted the obstruction of the track with the necessary machinery for driving the piles. The excavation was carried on underneath the platform between the piles, bracing being put in as the work proceeded. A very heavy timbering was found necessary to resist the side pressure of the soft clay. This pressure was so great that the 12×12-in. pine transverse braces crushed into the 12×12-in. oak waling timbers from ¼ to ⅜ in. At one point, also, considerable trouble was had from the swelling clay rising in the bottom of the excavation, which necessitated the filling of the excavation with stone until equilibrium was restored. This stone had, of course, to be removed little by little as the masonry was constructed. No trouble occurred after the invert was once in place.

In building the masonry the usual method was followed except that as the arch was turned a hole was left in the brickwork around each of the piles in the two inner rows. After a sufficient length of the arch had been finished short posts resting on the masonry were put in to take the place of the interior piles. The piles were then removed and the holes in the masonry filled in. All the other timbering was left in the ground when the excavation was filled. In Fig. 8 is shown the form of center used in building the arch masonry.

The tunnel has been built to carry the double-cable tracks of the West Chicago St. Ry. Co. and is stated to have cost $1,800,000, including land damages. Mr. S. G. Artingstall has been the chief engineer of the work and Mr. Charles V. Weston the engineer in charge of construction. The contractors were Fitzsimmons & Connell, of Chicago. We are indebted to Mr. Weston for the matter from which our illustrations have been prepared.

THE COST OF STREET LIGHTING WITH ARC LAMPS.

One of the latest cities to investigate the relative cost of electric arc street lighting under public and private ownership is Evansville, Ind., a city with a population of 50,756 by the last census. The investigation was made by the mayor, Mr. A. C. Hawkins, and the board of public works, consisting of Messrs. Jas. Scarborough, Moses Stinchfield and Jas. D. Saunders. The results of the inquiry, with recommendations, were published in "Light, Heat and Power" for March, 1894, and were substantially as follows:

On Aug. 10, 1885, the city of Evansville contracted for street lighting with the Evansville Gas & Electric Light Co. and at the time of the report was paying at the rate of $31,350 per year for an equivalent, approximately, of 198 2,000-c. p. arc lamps, or an average of $158.30 per lamp per year. These lamps were reported in Whipple's "Electrical Directory" for 1891 as burning all night on the moonlight schedule.

In response to inquiries sent by the city to 100 cities supplied with electric street lights by private companies, 63 replies, covering various points aside from the cost of lighting, were received and are given herewith as Table I. Some figures covering a part of the same ground, collected by the city of Springfield, Ill., are given separately in Table II. Inquiries sent to 75 cities operating their own electric light plants elicited 41 responses which are given in Table III., while Table IV., on the same subject, is from the Springfield data referred to above.

TABLE II.—Cost of Arc Electric Street Lighting by Private Contract as Ascertained by the Authorities of Springfield, Ill.

City.	Population.	—Lamps.— No.	Cost per annum.	Schedule.
Colorado Spgs., Colo.	11,000	—	$160.00	All night.*
Philadelphia, Pa.	1,046,900	1,000	152.00	All night.
Tacoma, Wash.	36,000	—	144.00	All night.
Minneapolis, Minn.	164,000	612	150.00	All night.
Manchester, N. H.	44,000	298	136.00	All night.
Pueblo, Colo.	24,000	100	132.00	All night.
Columbus, Ga.	17,000	40	126.00	All night.
New Orleans, La.	242,000	948	130.00	All night.
Duluth, Minn.	33,000	250	127.00	All night.
Waterbury, Conn.	24,000	159	121.00	All night.
Wilkes-Barre, Pa.	37,000	89	120.00	All night.
Springfield, Mo.	22,000	70	114.00	All night.
Wichita, Kan.	24,000	76	108.00	All night.
Rochester, N. Y.	134,000	1,000	104.00	All night.
Springfield, O.	32,000	150	100.00	All night.
Allentown, Pa.	25,000	114	100.00	All night.
Joliet, Ill.	23,000	200	100.00	All night.
Dallas, Tex.	38,000	125	93.85	All night.
Scranton, Pa.	75,000	400	91.00	All night.
Auburn, N. Y.	26,000	150	87.50	All night.
Williamsport, Pa.	24,000	200	80.00	All night.
McKeesport, Pa.	20,000	115	100.00	All night.
Hartford, Conn.	53,000	124	99.00	Moonlight.
Akron, O.	28,000	225	77.00	Moonlight.
Mobile, Ala.	31,000	134	76.50	Moonlight.
Youngstown, O.	33,000	237	67.50	Moonlight.
Dubuque, Ia.	40,000	200	65.00	Moonlight.

*For the all night plants we have estimated the average cost per light per annum of the above cities and find that it amounts to $114.58.

That part of the Evansville report which relates to these tables, together with other comments and the recommendations made, is given below, nearly in full. Especial attention is called to the paragraph relating to the difficulty of ascertaining the actual cost of street lighting under city ownership, a fact which, in justice to all concerned, should

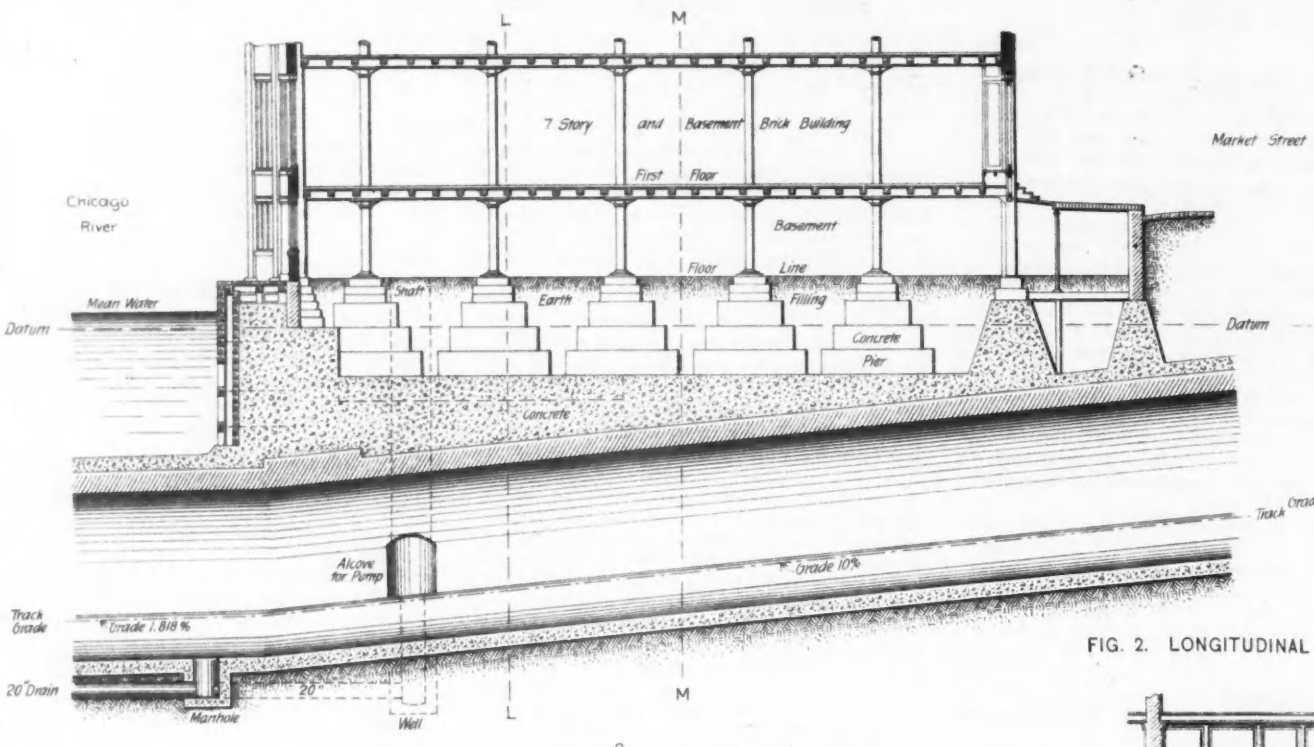
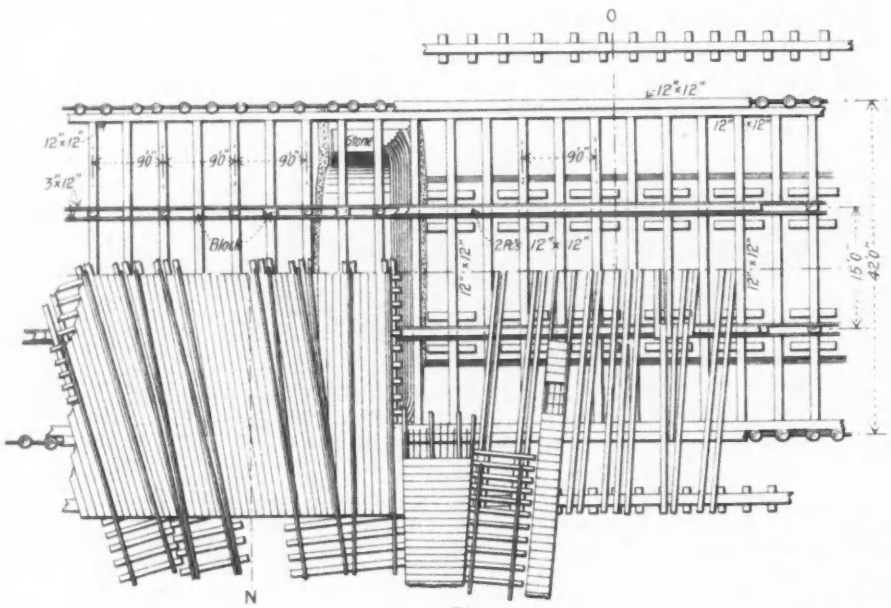
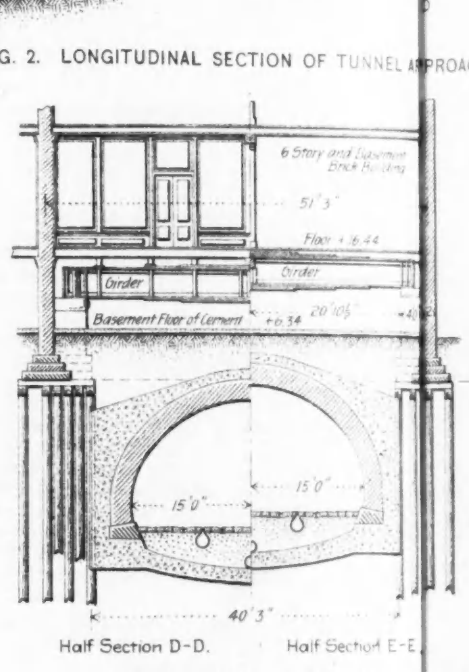


FIG. 2. LONGITUDINAL SECTION OF TUNNEL APPROACH

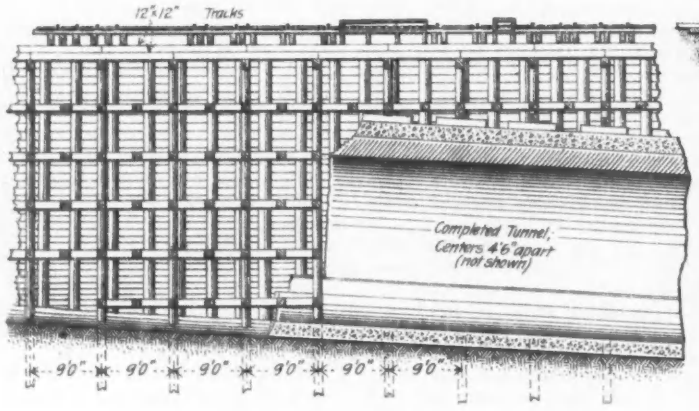


Plan.

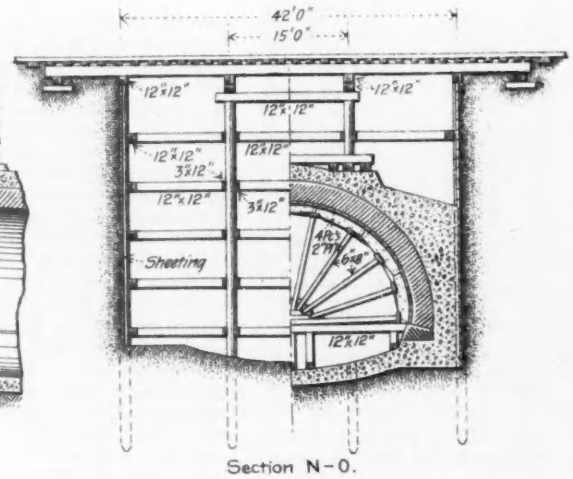


Half Section D-D. Half Section E-E.

FIG. 3. TRANSVERSE SECTIONS OF TUNN



Longitudinal Section.



Section N-O.

FIG. 7, PLAN AND SECTIONS SHOWING METHOD OF SUPPORTING RAILWAY TRACKS.

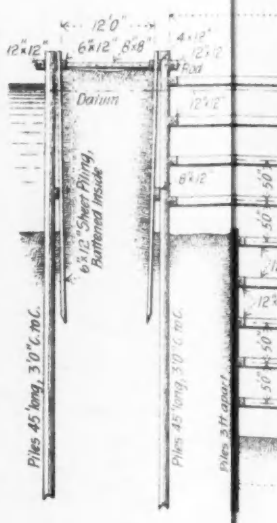
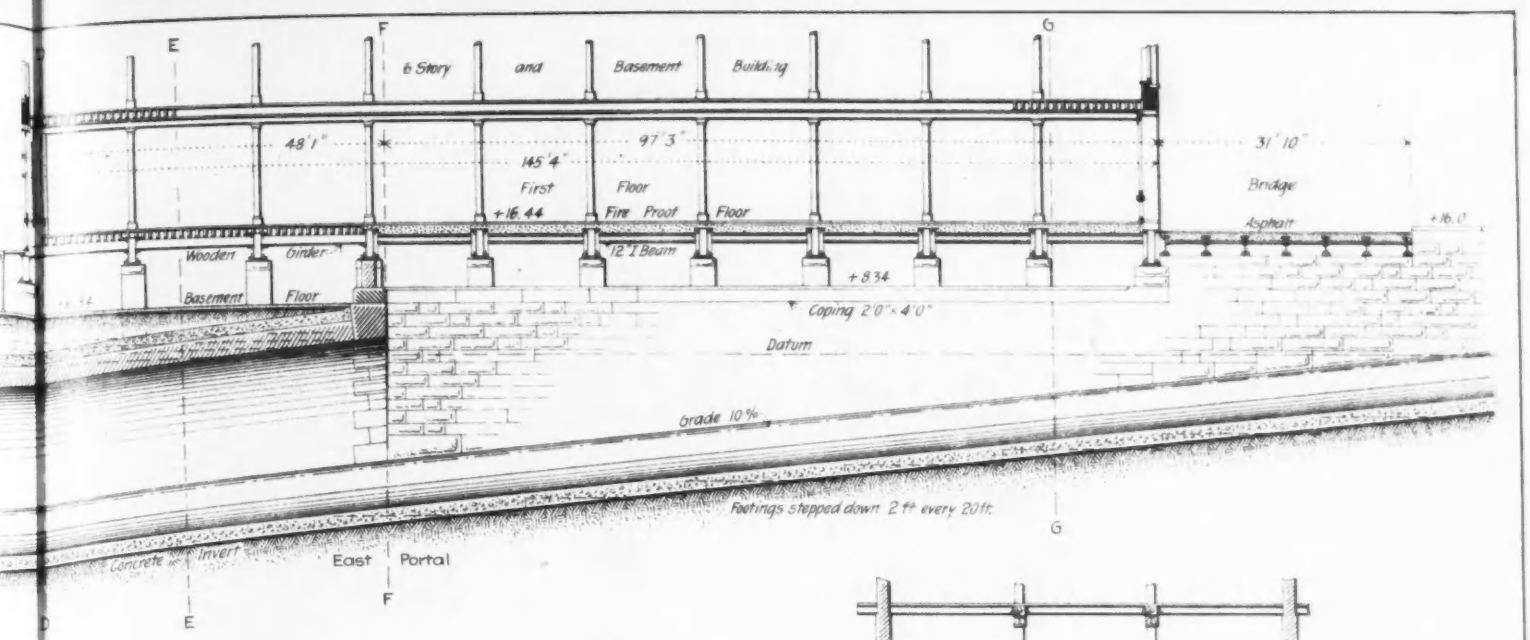


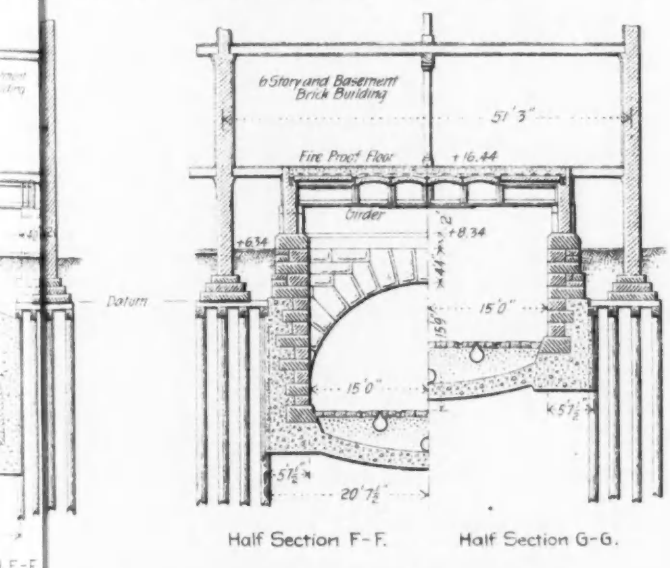
FIG 5. TRANSVERSE

CABLE RAILWAY TUNNEL UNDER CHIC
SPECIAL STRUCTURAL

S. G. Artingstall, Chief Engineer. West Chicago Street Railway Co., Builders. C.



NEL APPROACH AND FOUNDATIONS OF BUILDINGS ABOVE.



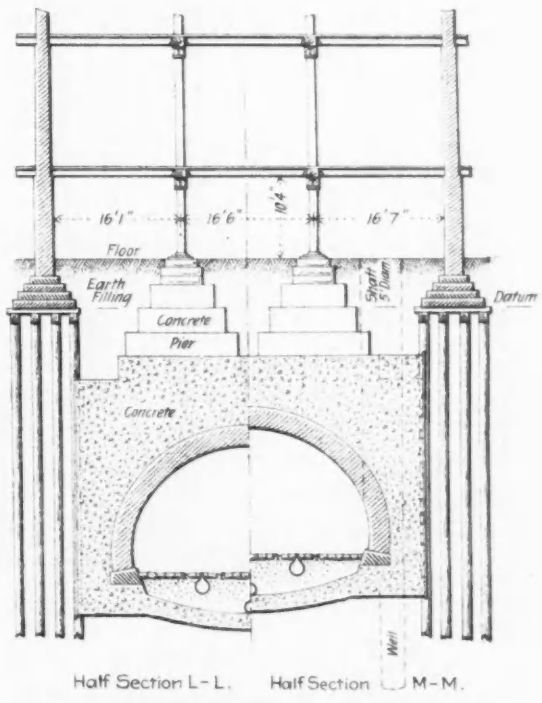
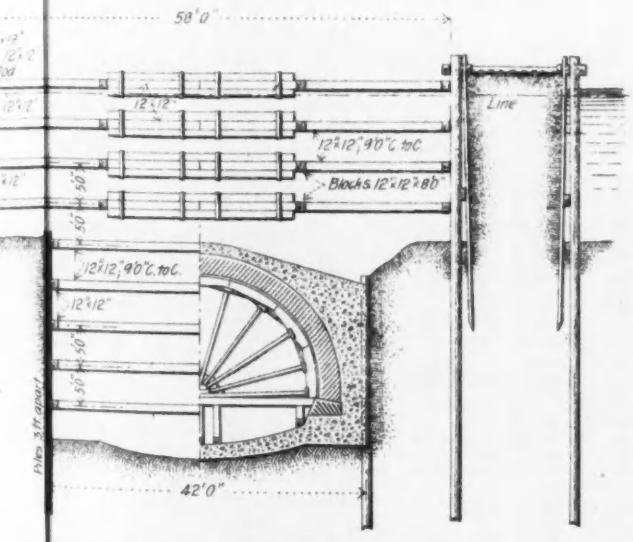


FIG. 4. TRANSVERSE SECTIONS OF TUNNEL AND FOUNDATIONS OF SEVEN STORY BUILDING.

TUNNEL AND FOUNDATIONS OF SIX STORY BUILDING.



TRANSVERSE SECTION OF COFFERDAM AND TUNNEL.

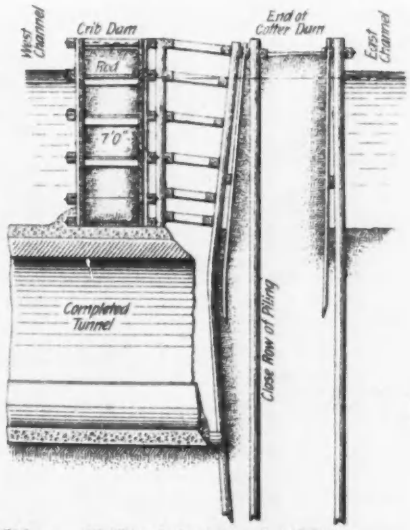


FIG. 6. SECTION SHOWING METHOD OF CONSTRUCTING CRIB DAM.

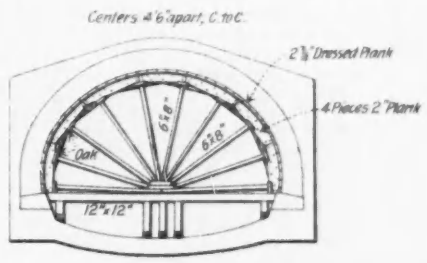


FIG. 8. TIMBER CENTER FOR TUNNEL.

DER CHICAGO RIVER, CHICAGO, ILL.

UCTURAL DETAILS.

lders. C. V. Weston, Resident Engineer. Fitzsimmons & Connel, Contractors.

CHAS. HART & SONS, LITH., 30 WEST ST., N. Y.

TABLE I.—COST OF ELECTRIC ARC STREET LIGHTING IN CITIES LIGHTED BY PRIVATE CONTRACT, WITH PRICES OF GAS.

City.	Population.	Lamps. Number.	Lamps. Cost per annum.	Total cost of lighting.	Schedule.	Price paid per 1,000 ft. gas. City.	Price paid per 1,000 ft. gas. Private consumers.	In your opinion, should cities do their own lighting?
New York, N. Y.	1,700,000	—	$164.25	$850,000	All night.	$1.25	$1.25	Yes.
Milwaukee, Wis.	204,000	—	110.00	——	All night.	.80	.80	—
New Bedford, Mass.	40,000	—	146.00	40,700	Moonlight.	—	—	Yes.
Lancaster, Pa.	32,000	—	127.75	35,000	All night.	1.50	2.00	Yes.
Grand Rapids, Mich.	60,000	300	146.00	45,000	All night.	—	—	Yes.
Norfolk, Va.	34,800	—	95.00	——	All night.	1.40	1.40	—
Boston, Mass.	448,000	—	146.00	——	All night.	.70	1.50	No.
Cambridge,, Mass.	70,000	447	115.00	——	All night.	1.20	1.20	Yes.
Toledo, O.	81,000	—	100.00	——	All night.	1.10	1.10	No.
Omaha, Neb.	140,000	—	175.00	60,000	All night.	1.00	1.00	Yes.
Omaha, Neb.	140,000	—	140.00	60,000	All night.	1.00	1.00	Yes.
Burlington, Ia.	23,500	—	100.00	12,000	Moonlight.	—	—	Yes.
Fort Wayne, Ind.	35,000	183	125.00	——	——	——	——	Yes.
Brooklyn, N. Y.	806,000	—	182.50	525,000	All night.	1.25	1.25	—
Kalamazoo, Mich.	17,800	—	172.50	15,000	All night.	1.00	2.00	Yes.
Hoboken, N. J.	43,000	—	——	24,000	——	1.75	1.75	—
Binghamton, N. Y.	35,000	252	109.50	——	All night.	1.00	2.00	Yes.
Cleveland, O.	261,000	—	88.60	200,000	Moonlight.	.80	.80	No.
Wilmington, Del.	61,000	—	164.25	30,000	All night.	1.25	1.25	Yes.
Denver, Colo.	107,000	600	150.00	96,000	Moonlight.	1.50	1.50	Yes.
Fall River, Mass.	74,000	—	162.50	62,000	All night.	1.00	1.00	—
Camden, N. J.	58,000	119	146.00	——	All night.	1.50	1.50	—
South Bend, Ind.	21,800	—	70.00	——	Moonlight.	—	—	Yes.
South Bend, Ind.	21,800	—	100.00	——	All night.	—	—	—
Detroit, Mich.	205,000	—	129.00	175,000	——	1.25	1.25	Yes.
Lynn, Mass.	55,000	—	146.00	60,000	All night.	1.30	1.30	—
Trenton, N. J.	57,000	—	134.50	50,000	All night.	2.00	2.00	Yes.
Utica, N. Y.	44,000	378	112.00	52,000	All night.	1.50	1.50	Yes.
Covington, Ky.	37,000	—	—	18,000	——	——	—	No.
Newport, Ky.	24,900	—	100.00	——	Moonlight.	1.10	1.00	No.
Peoria, Ill.	41,000	250	90.00	——	Moonlight.	1.50	1.50	Yes.
Syracuse, N. Y.	88,000	—	108.00	——	All night.	1.20	1.30	—
Racine, Wis.	21,000	—	80.00	——	All night.	—	—	Yes.
Des Moines, Ia.	50,000	—	72.00	40,000	Moonlight.	1.50	1.70	Yes.
Columbus, O.	88,000	850	75.00	75,000	Moonlight.	1.00	1.00	Yes.
Atlanta, Ga.	65,000	150	120.00	70,000	All night.	1.00	1.00	—
Baltimore, Md.	434,000	—	127.75	240,000	All night.	1.25	1.25	—
St. Paul, Minn.	133,000	—	127.75	160,000	——	—	—	—
Pittsburg, Pa.	238,000	500	96.00	——	——	—	—	—
Buffalo, N. Y.	255,000	—	127.75	——	——	1.00	1.00	—
Quincy, Ill.	31,000	260	75.00	——	Moonlight.	1.50	1.50	No.
Leavenworth, Kan.	19,000	—	96.00	7,500	All night.	1.50	1.50	—
Council Bluffs, Ia.	21,400	—	164.25	——	Moonlight.	2.00	2.00	—
Newark, N. J.	181,000	—	127.25	163,000	All night.	1.40	1.40	Yes.
Washington, D. C.	230,000	330	182.50	——	Moonlight.	1.25	1.25	Yes.
Springfield, Ill.	25,000	147	137.00	——	Moonlight.	1.50	1.50	Yes.
Michigan City, Ind.	10,700	100	75.00	——	Moonlight.	—	—	Yes.
St. Louis, Mo.	451,000	2,000	75.00	——	All night.	1.25	1.25	Yes.
Harrisburg, Pa.	39,000	285	88.50	——	All night.	1.50	1.50	No.
Erie, Pa.	40,000	276	116.80	——	All night.	1.00	1.00	Yes.
Cincinnati, O.	296,000	—	84.00	261,000	Moonlight.	1.00	1.00	No.
Indianapolis, Ind.	105,000	800	85.00	——	Moonlight.	1.25	1.25	—
Nashville, Tenn.	76,000	255	95.00	——	All night.	1.50	1.50	Yes.
Louisville, Ky.	161,000	—	84.00	74,100	All night.	1.30	1.30	—
Montgomery, Ala.	21,800	—	90.00	20,532	All night.	1.00	2.00	Yes.
Chattanooga, Tenn.	29,100	200	96.00	19,400	All night.	1.50	1.50	Yes.
Birmingham, Ala.	26,100	—	96.06	18,793	All night.	1.00	1.25	Yes.
Dayton, O.	61,100	156	125.00	40,425	All night.	1.00	1.00	Yes.
Canton, O.	33,000	120	70.00	——	——	1.20	1.20	—
Roanoke, Va.	25,000	—	87.60	8,640	All night.	1.75	1.75	Yes.
Houston, Tex.	27,500	—	150.00	——	All night.	3.00	3.00	—
Lincoln, Neb.	55,000	—	100.00	——	Moonlight.	1.80	1.80	—
Savannah, Ga.	43,000	—	100.00	28,000	Moonlight.	1.70	1.70	Yes.
Albany, N. Y.	95,000	—	150.00	91,855	All night.	1.70	2.00	Yes.
Terre Haute, Ind.	30,000	290	70.00	20,000	——	.50	.50	Yes.

TABLE III.—COST OF BUILDING AND OPERATING MUNICIPAL ELECTRIC LIGHTING PLANTS.

City.	Population.	Plant erected.	Original cost.	Lamps. Number.	Lamps. Cost per annum.	Total yearly cost of lighting.	Schedule.	Should cities do their own lighting?	Remarks.
Muncie, Ind.	11,300	1892	$23,000	234	—	$3,823	——	Yes	No interest or depreciation.
Metropolis, Ill.	—	1892	51,000	34 arc 66 ind	$75.00 41.43	3,000	——	Yes	
Dunkirk, N. Y.	9,400	1887	10,000	75	—	——	Moonlight	Yes	
Batavia, Ill.	—	1889	40,000	120	—	——	All night	Yes	Cost nothing; expenses paid by
Hannibal, Mo.	12,800	1885	46,911	150	50.00	——	——	Yes	Commercial light. See letter sent.
Decatur, Ill.	16,800	—	19,000	120	50.00	——	Moonlight	Yes	2,500 incandescent.
Anderson, Ind.	10,700	—	27,550	150	40.00	6,000	All night	Yes	
Chicago, Ill.	1,099,000	—	——	1,109	100.00	——	——	—	Rented light, $137.
Paris, Ill.	5,000	1887	10,000	—	58.00	2,200	——	Yes	Operated with water-works.
Easton, Pa.	14,400	1886	33,000	114	82.40	——	All night	Yes	
Crete, Neb.	—	1891	10,000	50	40.00	2,200	——	Yes	
Lewiston, Me.	21,700	1887	14,000	100	43.00	5,500	——	Yes	
CouncilGrove,Kan	—	1888	6,000	20	—	3,000	——	Yes	42 incandescent; clears its own expenses after deducting interest, etc.
Margarette, Mich.	9,000	1889	70,000	100	60.00	——	——	Yes	
Buena Vista, Va.	—	1890	25,000	50	—	3,600	——	Yes	1,300 incandescent.
Painesville, O.	—	1888	13,000	70	43.60	3,448	——	Yes	
Troy, Ala.	—	1891	20,000	50	100.00	5,000	——	No	
Albany, Mo.	—	1892	13,000	30	85.00	2,550	——	No	1,200 c. p.
Titusville, Pa.	8,000	1887	8,000	59	47.00	——	——	Yes	See letter sent.
Gainesville, Ga.	—	1890	10,000	50	50.00	2,500	——	—	Debatable.
Hudson, Wis.	—	1892	7,000	50	36.00	1,800	——	Yes	1,200 c. p.
Lyons, Ia.	5,700	1887	17,500	59	85.00	——	——	Not	in Iowa.
Chariton, Ia.	—	1889	22,000	100	36.00	3,600	——	No	1,400 incandescent.
Madison, Ga.	—	1891	22,000	39	115.00	4,500	——	—	
Bowl'g Green,Ky.	7,800	1888	15,000	72	65.00	——	——	Yes	
Herrington, Kan.	—	1888	20,000	18	—	——	——	—	Light cost nothing; 400 incandescent.
Marshaltown, Ia.	8,900	—	11,000	65	17.00	1,100	——	Yes	See letter.
Portsmouth, O.	12,300	1889	30,000	130	38.50	4,500	——	Yes	
St. Peters, Minn.	—	—	12,500	45	—	——	——	Yes	Costs nothing; runs with W. W. 1,000 incandescent.
Bluffton, Ind.	—	—	18,500	42	64.30	2,700	——	Yes	38 iacandescent.
Frederick, Md.	8,100	1888	15,000	65	60.00	3,900	——	Yes	
Chambersb'g, Pa.	7,800	1889	17,000	70	72.00	5,200	——	Yes	
St. Charles, Mo.	6,600	1890	17,000	92	30.00	5,000	——	Yes	Receives $2,250 for private; 30 commercial lights.
Cuyahoga Falls,O.	—	1890	15,000	52	70.00	——	——	Yes	
Salem, Va.	—	1891	27,000	50	—	5,500	——	Yes	650 incandescent.
Little Rock, Ark.	25,800	—	47,000	136	70.00	——	Moonlight	Yes	
Crawf'dsv'l, Ind.	6,000	1891	80,000	142	45.00	——	——	Yes	2,400 incandescent.
Madison, Ind.	8,800	1886	20,907	86	58.00	5,000	——	Yes	
Wheeling, W.Va.	34,500	—	125,000	400	65.00	——	——	Yes	
Allegheny, Pa.	105,000	—	200,000	565	72.00	——	——	Yes	2,000 incandescent.
Huntington, Ind.	7,300	1886	14,000	53	50.00	——	——	Yes	

never be forgotten. The report goes on substantially as follows:

From the foregoing statements we calculate the average price paid for light by cities having private contracts, and find the same to be $114.59 per lamp per annum, while the average price per annum to cities operating their own plant is only $57.88.

We requested a number of expert electricians to give us an estimate on the entire cost of a first-class electric plant for this city, complete in all its details, with 320 arc lamps. This was done by three of these electricans, who came to our city and made a careful investigation of the situation, and the highest estimate made by any of them was $70,000, and the lowest $60,000.

We received by mail letters from quite a number of cities that are now lighting by private contracts, but are advertising for bids preparatory to building their own plants. Among these are Hamilton, O.; Dallas, Tex.; Detroit, Mich.; Springfield, Ill., and many others of equal prominence. Hamilton, O., is now doing her own lighting with gas and is advertising for an electric plant.

The claim has been made to your committee by those interested in private lighting, that it is only small cities and towns that are engaged in doing their own lighting. This statement we found to be incorrect. It is quite apparent that this argument is used for the sole purpose of discouraging this city from building her own lighting plant.

Another objection raised by these persons is that politics dominates municipal governments, and therefore it would not be possible for a city the size of Evansville to do her own lighting as cheaply as it can be done by a private company. In the opinion of your committee the citizens of Evansville are not so wedded to partisan politics as to annually sacrifice from $15,000 to $20,000 of their hard earnings for the sole purpose of furnishing employment to incompetent men, who possess no other qualifications than their political claims. Under our present form of city government, it is quite as possible to conduct any institution maintained by the city as successfully and cheaply as any business enterprise can be conducted by a company or corporation.

After having given this question a careful investiga-

TABLE IV.—Cost of Building and Operating Municipal Arc Electric Street Lighting Plants as Ascertained by the Authorities of Springfield, Ill.

	Population.	Original cost of plant.	Lamps. No.	Lamps. Yearly cost.	Should cities do their own lighting?
Bloomington, Ill.	20,400	$73,000	220	$51.60*	Yes.
Bay City, Mich.	27,800	30,000	180	46.00**	Yes.
Jamestown, N. Y.	16,000	28,000	137	44.00	Yes.
Aurora, Ill.	19,600	41,800	162	58.40***	Yes.
Marietta, O.	8,200	18,000	110	60.00	Yes.
Elgin, Ill.	17,800	....	100	62.00	Yes.
Alexandria, Va.	14,000	16,000	92	55.00	Yes.
Ashtabula, O.	8,300	25,000	120	77.00	Yes.
Chambersburg, Pa.	7,800	20,000	72	78.00	Yes.
Galion, O.	6,300	30,000	72	65.00	Yes.
Coldwater, Mich.	5,200	....	70	59.00	..
So. Norwalk, Conn.	....	22,500	90	..	..
Santa Cruz, Cal.	5,500	....	74	50.00	..
West Troy, N. Y.	12,900	22,000	90	60.00****	..

* Paid $111 private contract. ** Paid $100 private contract. *** Paid $362.92. **** Paid private company $70.

tion, your committee submits the following conclusions:

1. That our city is now paying over 60% more for her street lighting than she ought to do.

2. The 55 cities doing their own lighting pronounced the same a complete success, and we have ascertained the average cost thereof per light per annum to be $57.88.

3. That cities lighted by private contract are paying on an average per light per annum $114.58.

4. That our city is very poorly lighted and should have about double the lights which she now has.

5. That the entire cost of building an electric lighting plant for our city, with 350 lights, would not exceed $75,000, and the annual cost of maintaining such a plant in this city would not exceed $50 per lamp per annum, or a total sum of $17,500 annually.

In calculating the average cost per light per annum to cities operating their own lighting plant, we have not taken into account the cost to cities where the plant is operated in connection with the water-works system, nor where the cities also furnish commercial lights. In cases of this kind we find it difficult to ascertain just what the actual cost of the street lighting is, but a number of these cities have written letters to your committee, claiming that their street lighting costs practically nothing, for the reason that the commercial lights more than pay for the running expenses of the plant. In our own city, for instance, should the lighting plant be operated in conjunction with the water-works, we are informed by expert electricians that the cost of operating the lighting plant would be greatly reduced.

And should commercial lighting be added, the revenues received therefrom would still further reduce the operating expenses of the plant.

The experience of cities owning their own electric and gas plants is that the same can be maintained and operated far cheaper than the same is done by private companies.

Your committee has also ascertained that municipal ownership of all plants, such as water-works, street

railways, lighting and others necessarily requiring franchises from the public should in the opinion of the best thinkers of the age, who have studied municipal government, be owned by the public, instead of by private corporations. One of the most serious mistakes now chargeable against all American cities of the present century is the reckless "giving away" of valuable franchises of every description to private corporations and companies. Evansville, along with the balance of her sister cities, is now suffering from this kind of folly, committed in the past.

Your committee is of the opinion that a new contract for our street lighting could now be let for a much lower price than the present contract calls for, but we do not believe it to be for the best interest of the citizens of this city for her lighting to be done by private contract. We would recommend, therefore, that your honorable body pass the necessary ordinance authorizing the Department of Public Works to build a lighting plant for our city with not less than 300 arc lamps, to be operated in connection with the water-works, and that a sufficient levy therefor be made next September. Said plant should also provide for incandescent lights and power that could be sold to private citizens desiring the same, thereby materially reducing the expenses of operating the plant.

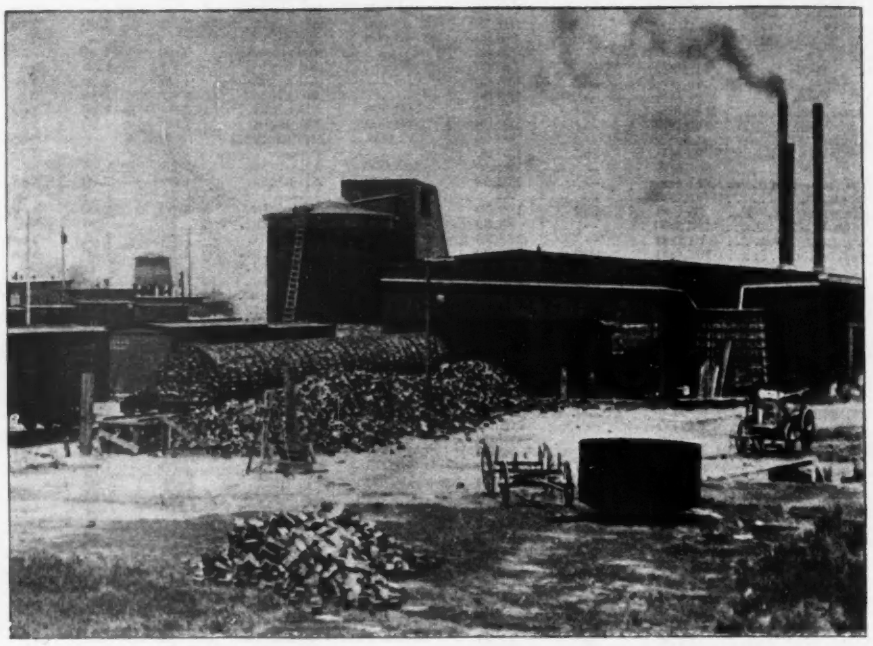
Since the above was put in type we have learned that the common council of Evansville has authorized the department of public works to advertise for bids for constructing an electric lighting plant, but money for the plant has not yet been provided.

CREOSOTING WORKS OF RICKER, LEE & CO., GALVESTON, TEX.

A creosoting plant has lately been completed for Messrs. Ricker, Lee & Co., at Galveston, Tex., by Mr. J. W. Byrnes, contractor, which is somewhat of an innovation on ordinary methods of constructing such plants. It has what is believed to be the largest treating cylinder in existence. It has been constructed especially for creosoting paving blocks, though the owners contemplate making some changes which will make it one of the most complete plants for general creosoting in operation The following description with accompanying plans and illustrations were furnished by Mr. J. N. Huston, C. E., under whose supervision the plant was constructed and who has made creosoting a special study for a number of years. He also supervised the construction of a creosoting plant for the Wharf Co., of Galveston, some three years ago.

The treating cylinder is a cylindrical shell of 1½ in. steel, of 60,000 lbs. tensile strength, 9 ft. inside diameter and 100 ft. long exclusive of hemispherical doors. It was constructed by the Williamson Iron Co., of Birmingham, Ala. The cage cars for holding the blocks while being treated, were built by the same firm. Each car holds 5,000 ft. B. M. when loaded loosely with blocks of the size now being treated.

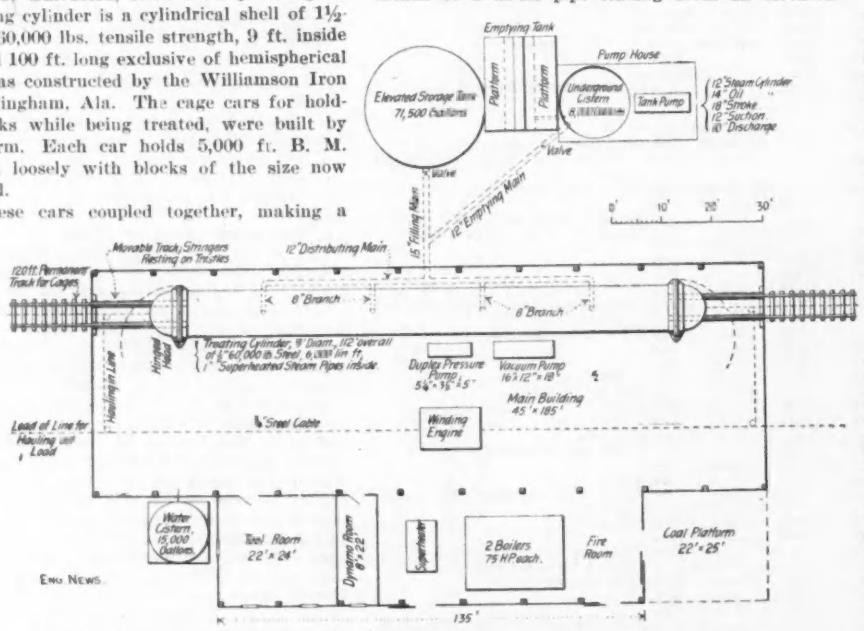
Six of these cars coupled together, making a train holding 30,000 ft. B. M., are run into the cylinder at each charge, making a daily output for the works of 60,000 ft. B. M. Each car runs on four 18 in. wheels. Inside of the cylinder a track of 40-lb. steel rail is riveted to the shell by means of brackets. Movable stringers are placed on trestles connecting the track in the cylinder with the track outside, forming a continuous track upon which trains are hauled into and out of cylinder by means of a winding engine and steel wire cable. After pulling in a train the movable track is taken away and the doors are closed and bolted in place, being rendered tight by means of an annular tongue on the cast iron doors fitting into an annular groove on the cylinder in which a gasket of heavy canvas belting is fitted.



VIEW OF EXTERIOR OF CREOSOTING WORKS, SHOWING OIL STORAGE TANK, AND CAGES LOADED READY TO HAUL IN.

The timber is seasoned by passing steam, superheated to some 700° F., through 6,000 lin. ft. of 1-in. heating coils inside of the cylinder, while a vacuum of 15 to 20 ins. is maintained in the cylinder. After seasoning, the creosote oil is admitted until the cylinder is filled. This is accomplished by means of a 15-in. pipe leading from an elevated storage tank of 71,500 gallons capacity. This pipe leads to a 12-in. branch, which in turn delivers the oil to the cylinder through four 8-in. valves in its bottom. Six minutes are required to fill the cylinder, after which the four 8-in. valves are closed and oil is forced into the cylinder by means of a duplex pressure pump until the timber has received the required amount of oil. The oil is then run off through a 12-in. Y leading from the 15-in. supply main into an underground tank, from which it is returned to the elevated tank by means of a tank pump of large capacity.

The cages are then pulled out on the same track from which they were taken in and another loaded train is pulled in from the opposite end. The green blocks are received from the mills in box cars and are loaded directly into the cages from a track running alongside the cage track. The creosoted blocks are discharged through suitable hinged doors onto the ground on the opposite side, and from there are hauled away to the streets.



GENERAL PLAN OF CREOSOTING WORKS OF RICKER, LEE & CO., GALVESTON, TEX.
J. N. Huston, Designing Engineer; J. W. Byrnes, Contractor.

Messrs. Ricker, Lee & Co. are now filling a contract for laying 40 blocks of creosoted pavement in Galveston, for which 3,500,000 ft. B. M. of lumber is required. Believing that there is likely to be an increasing demand for this popular and durable pavement, they felt justified in the construction of this plant. The present contract calls for heart yellow pine blocks 5 × 6 ins. in section and 6, 8 and 10 ins. long, to receive not less than 10 lbs. of oil per cu. ft.; and a guarantee of ten years is given on the pavement.

The manner of gaging the quantity of oil put in the timber is as follows: A wire attached to a float on inside of storage tank leads to a gage inside of the building which is graduated to feet and decimals, up to 20 ft., the depth of the tank. A table calculated for each decimal shows at a glance the number of gallons of oil represented by the index of the gage. The exact contents of the cylinder and pipes leading to it from the tank being known, the load displacement, including cages, all reduced to gallons, is subtracted from this, the remainder showing space unoccupied in cylinder. To this space add the number of gallons required to be absorbed by the timber and the sum is the total number of gallons that must be put in the cylinder to fill it and force the required amount of oil into the timber. The following is a copy of record as kept for each charge made:

Load No. 93.	Oct. 11, 1893—Wednesday.	
Cylinder space, empty.....		51,500 gals.
Displacement, 29,400 ft. B. M. blocks = ...	18,326 gals.	
6 cages at 16½ cu. ft. = 99 cu. ft. = ...	740 gals.	19,066 gals.
Cylinder space loaded.....		32,434 gals.
29,400 ft. B. M. = 2,450 cu. ft. to receive 10 lbs. oil per cu. ft. = 24,500 lbs. = .		2,784 gals.
Oil required in cylinder.....		35,218 gals.
Gage A. 13.25 = 47,361 gals. Oil required in cylinder = 35,218 gals.		
Gage B. 3.40 = 12,143 gals. (Run back to 3,375.)		

Check.
Gage A. 13.25 = 47,361 gals.
Gage C. 12.45 = 44,502 gals.

Oil actually put in blocks = .. 2,859 gals.

$\frac{2,859 \times 8.8}{2,450}$ = 10.27 lbs. per cu. ft. put in blocks.

Vacuum on 7:45 a. m.
Oil on..... 3:00 p. m. = 7¼ hrs. vac.
Pressure off 4:45 p. m. = 1¾ hrs. pres.
Oil off..... 5:30 p. m. = 2½ hrs. oil.
Max. vacuum, 13 ins.; max. oil pres., 60 lbs.; max. superheater, 600°.

Gage A represents oil in storage tank previous to filling cylinder. Gage B represents point to which gage must be brought back to put required amount of oil in blocks at calculated quantity per cu. ft.

Gage C is the standing of gage after the oil has been run off the charge and returned to storage tank. The difference between gages A and C shows the exact quantity of oil absorbed by the blocks.

This difference multiplied by 8.8, the number of pounds of oil in one gallon, and divided by number of cubic feet of blocks in one charge, gives the average number of pounds of oil per cubic foot put in the blocks.

The plant furnishes its own electric lights, being lit by five arc and six incandescent lamps and is most complete in every respect, reflecting great credit on its constructor, Mr. J. W. Byrnes.

INTERIOR VIEW, SHOWING TREATING CYLINDER AND WINDING ENGINE.

THE MINNESOTA CANAL.

By Allan Ross Davis.

The Minnesota Canal Co. was organized a year ago, with headquarters in Duluth, for the purpose of supplying the cities and towns at the head of Lake Superior with hydraulic power for present and prospective manufacturing purposes, and with water for fire protection and household use. At present steam power amounting to about 40,000 HP. is in use in Duluth, Superior and their suburbs. The supply of water for the proposed canal will be obtained from the St. Louis River, a stream rising in the northern part of Minnesota. The general elevation of its watershed is 2,000 ft. above the level of Lake Superior, and the area drained by it is approximately 3,700 sq. miles. The Minnesota Canal Co., a corporation organized by Chicago, St. Paul, Minneapolis and Duluth capitalists, proposes to dam the St. Louis River at a point about 25 miles from Lake Superior and at an elevation about equal to that of the heights in the rear of Duluth, some 600 ft. above the lake. From the dam to Duluth an artificial channel would be constructed. A reservoir is proposed at the terminus of the canal sufficiently large to hold the maximum amount of water that may be required. From this reservoir steel conduits would lead to the distributing mains below and to the mills and factories.

After the formation of the Minnesota Canal Co. three fully equipped parties were immediately placed in the field to make the necessary preliminary surveys.

Starting at the proposed dam site on the St. Louis River, about 25 miles from Duluth, at which locality the river is 500 ft. wide and has an average depth of 6 ft. at midsummer low water, an excavation about 10 ft. deep through a tamarack swamp, will lead to a ravine, five miles long, known as Dutch's Slough. Through this ravine, which was probably once a secondary or overflow outlet of the St. Louis, there need be little or no excavation to obtain the required depth, while its width will permit the storage of a large volume of the descending floods during the rainy seasons. The ravine discharges into the White Pine River, which, after flowing 1½ miles in a southwesterly direction, empties into the St. Louis.

It is proposed to utilize the White Pine as a canal for a mile or more, and then at the lowest practicable elevation thereof to throw a dam across the river, extending out to the high ridges on either side and raise the water to the required level. The location of the canal southerly from the White Pine for a distance of about seven miles is around the high bluff of the St. Louis River.

The excavation on this section of the work will be through clay and sand, with occasional boulders, and will be in cut and fill for the entire length. The river continues to flow southerly for several miles before turning to the northeast on its progress to Lake Superior, which renders the further following of the river by the canal impracticable. It is here proposed to cross the country in an almost direct line to the terminus of the canal at Duluth, a distance of 12 miles. The intervening country consists of ravines, hills and plateaus, partly wooded with pine, tamarack and poplar or birch. The excavation will be through earth and occasionally through rock and loose boulders. Some deep ravines here also extend for a considerable distance in practically the required course of the canal route, and will consequently need but little work in the way of excavation, although the damwork at their lower ends will be a matter of importance.

The computed area of the watershed drained by the St. Louis, as stated above, is about 3,700 sq. miles. Assuming an annual rainfall of 34 ins., with one-fourth of that amount, or 8½ ins., flowing into the river, would give a flow of 108 cu. ft. per sq. mile per minute, affording 475,000 HP. After carefully estimating the possible consumption of water, it has been deemed advisable in view of the rapid growth likely to take place in the future in Duluth and Superior, that the cross-section of the canal should be 120 ft. wide at the surface and 20 ft. deep at the center, with side slopes of 3 to 1.

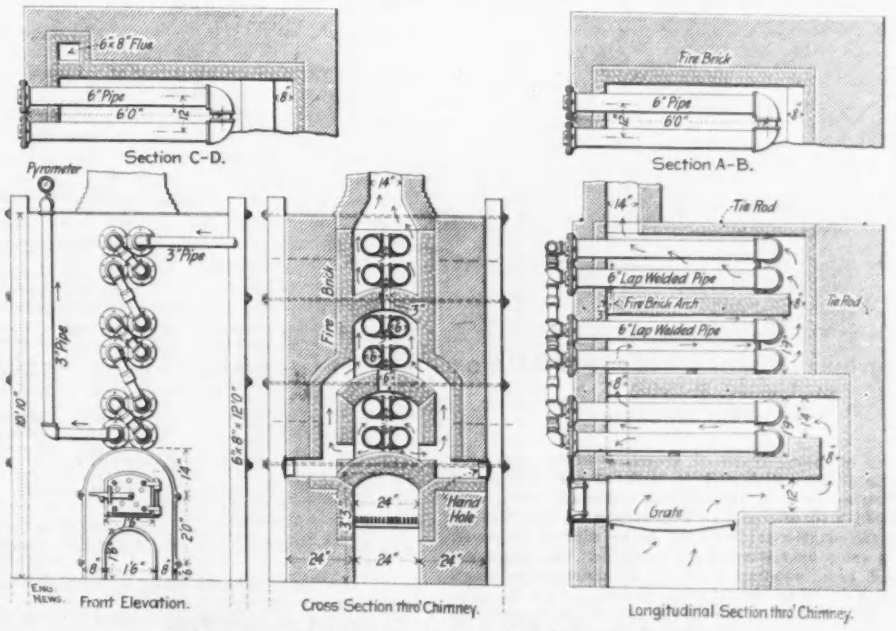
With a velocity of ½ mile per hour, this canal should be capable of furnishing 240,000 HP., at a point 630 ft. below the reservoir in the city of Duluth, an amount of power six times as great as that now being consumed at the head of the lake.

It has been thought advisable to make the steel conduits leading from the reservoir on the heights to the consumers below at least 6 ft. in diameter. This would give an approximate capacity of 20,000 HP. each, and the canal would supply twelve 6-ft. conduits. A sufficient number of these will be laid to supply the present demand and others will be added as necessity demands. These proposed conduits will weigh about 448 lbs. per lin. ft., and they will be made of best soft steel. At 4 cts. per lb., and with a length of main of 4,000 ft., the cost would be $71,680; which, together with the items of construction and excavation, would render the cost of each conduit about $100,000.

In order to supply consumers at West Duluth, and in its vicinity, as well as those in the three Superior towns on the south side of the St. Louis Bay, it has been decided to build another reservoir on the line of the canal some three or four miles west of the terminus at Duluth. This will permit of the conduits being laid directly into West Duluth with the shortest possible intervening distance; and, moreover, will admit of crossing the bay, where a long projecting point leaves but a narrow expanse of water to cross. The reservoir located here on the high ridge, north of West Duluth, will necessarily be the larger one, and could be made to answer for the supply of Duluth, as well, thus avoiding any further extension of the canal. It is believed, however, that the present intention of the canal company is to build the two reservoirs.

The company stipulated to furnish all the power necessary to meet present and future demands at a maximum cost to consumers of $15 per horse power, and secured a franchise from the city of Duluth on that basis, after which surveys were begun a year or so ago, as already stated.

At that stage the canal company unwisely, it was felt by those citizens most favorable to the canal project, decided to avail itself of the provisions of an act passed in the last session of the state legislature by which counties, upon applica-



STEAM SUPERHEATER USED IN CREOSOTING WORKS.

tion, can vote sums of money in aid of canal projects if at the election a majority of voters are favorable to the scheme. The company asked for $600,000, to be issued in bonds in three series of $200,000 each, payable in 10, 20 and 30 years, respectively. The company agreed to issue $600,000 of its capital stock to the county at par and to charge only $10 per horse power per annum for its water.

A strong opposition to the proposal was immediately aroused and only a corporal's guard supported the bonus. (See Eng. News, June 8 and 22, 1893, for brief news note and editorial comment, respectively.—Ed.)

While $15 per horse power per annum is a very small rental as compared with the cost of steam power, yet when compared with the rental of water power in other localities, it may seem somewhat excessive. For example, in the city of Holyoke, Mass., a "mill power," for which an annual rental of $300 is paid, gives the consumer the right during 16 hours of the day to draw from the nearest canal 38 cu. ft. of water per second under a head of 20 ft. This is equivalent to 89 HP., or a rental of $4.62 per HP. per annum, which is considerably less than one-fifth of the lowest estimate of the cost of steam power. But Holyoke, with its cheap canal running past the doors of its numerous patrons is in the East, while Duluth with an expensive canal system, is in the West, where rates and rentals of all kinds are necessarily higher, particularly steam power, owing to the excessive cost of coal. The most practical argument possible in justification of the Minnesota Canal Co.'s stipulation of so high a rental, is that the users of power will gladly pay it.

FOUNDATIONS OF THE CHEAT RIVER BRIDGE, BALTIMORE & OHIO R. R.*

By Cecil B. Smith.

The Cheat River bridge was built in 1892-93, by the Baltimore & Ohio R. R., on the State Line R. R. between Uniontown, Pa., and Morgantown, W. Va. It consists of four 135-ft. through spans, and two half-through plate girder spans, 85 ft. and 65 ft. long, making the total length of the bridge 690 ft. In locating the piers, the triangulations were carried out in duplicate and checked to 0.1 ft.; the average was taken and found afterward by actual measurement to be within 0.05 ft. of being correct.

The soundings for pier foundations disclosed a thin layer of closely-cemented gravel, overlying soft clay shale at piers 2, 3, and 4; 13 ft. of mud and gravel overlying rock at pier 5, and apparently solid rock within 7 ft. of water surface at pier 1. This last information afterwards proved to be entirely incorrect, and came near causing great trouble. The seemingly solid rock, obtained in about 15 different readings, which all made the rod ring, was merely a solid mass of huge boulders forming the toe of an ancient slip from the mountain side adjacent, extending from about 200 ft. above the water to the bottom of the river, and varying from 3 to 20 ft. in thickness.

When the cofferdam (made by an artificially-made filling, above water level, into which sheet piles were hand-driven) encountered these boulders, driving had to be discontinued, and another row of sheeting and ring of timbers put in. This was, with much difficulty, carried down completely past the slipped material to a firm clay foundation, nearly level with the foundations of the river piers. The masonry base was well spread out, and the pier has not settled by the slightest noticeable amount, when tested by levels.

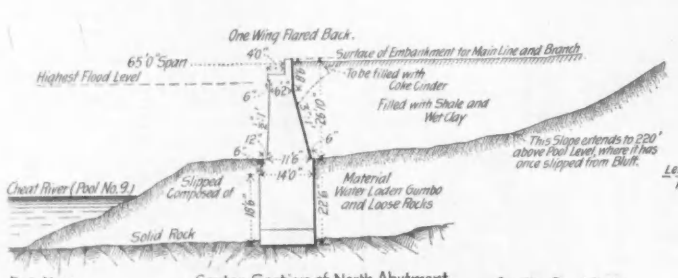
The foundation for the north abutment was commenced before that of pier 1, the material being wheeled to form the artificial dam mentioned; and as it was supposed that solid rock was within 7 ft. of water level, or 16 ft. of ground surface, or even less, no great difficulties were looked for. It was accordingly thought ample to lay out a foundation pit 4 ft. all around larger than the proposed abutment, which was to be 12 ft. 6 ins. at its greatest width. Here would seem a good opportunity to warn beginners in foundation work of any great possible depth: "Be sure to lay out pits amply large for supposed needs, and then add 1 or 2 ft. all around for contingencies."

After this foundation was carried down 12 ft., the old slip before mentioned consisting of clay and boulders was encountered, and it became evident that the pit must be carried down past this layer, at least to a firm clay. A second row of sheeting was necessary, and the question at once arose, whether the abutment, as originally designed, was heavy enough to withstand the pressure of a mountain side behind, liable to move at any moment, and with only a narrow support between the abutment and the river. (See cross-section in accompanying cut.)

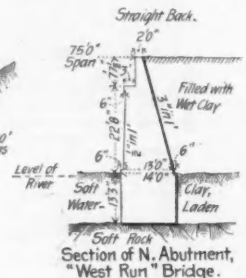
It was resolved to carry down as large a foundation pit as possible and fill it with masonry. Soft rock was obtained 23 ft. below ground, or about 49 ft. below grade, and a width of 14 ft. was given to the masonry and concrete. This width was carried up to the neat work, and all spaces between the masonry and sheeting were carefully rammed with concrete or earth; the remainder of the abutment was built according to plan.

During the excavation of this foundation the pressure on the timbering was enormous. The 12 × 12-in. struts were spaced 6 ft. apart longitudinally, and the rings were about the same distance apart vertically; but these were found, in places, to be crushing the timber rings to such an extent as to require many extra ones. There is no doubt but that the building of a spur from the main line at this point, along with the embankment for the main line itself, had put the mountain side out of balance, and the whole mass was pressing on the back of the excavation timbering. This point is made clear by two facts, which were discovered during the progress of the work: (1) A bench mark on a very large sound stump 200 ft. up the river from the abutment had settled 0.22 ft. before its movement was discovered; (2) a deep well about 500 ft. down the river from the abutment was 2 or 3 ft. out of plumb, although only dug for 2 or 3 years. The whole country along the banks of the Cheat and Monongahela Rivers is in a state of unrest, and needs hardly any provocation to make it move slowly but surely towards the river's edge.

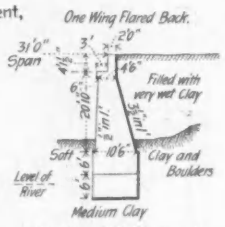
On bringing the embankment forward after the abutment was completed, a slight crack appeared in the flared back wing, but on ceasing to add new material when almost completed, the crack ceased to enlarge, and the abutment is since standing all right. By adding a few cars of coke cinders, the load will not be appreciably increased and the embankment will be completed. This abutment was thoroughly well built of the very best description of first-class masonry facing, with heavy, well-bonded coursed rubble backing, the average size of stones being about 2½ × 5 × 2 ft. The work was done under the closest inspection, very few spalls were used, and an abundance of mortar where needed.


One Wing Flared Back.
65'0" Span
Highest Flood Level
Surface of Embankment for Main Line and Branch.
To be filled with Coke Cinder
Filled with Shale and Wet Clay
This Slope extends to 220' above Pool Level, where it has once slipped from Bluff.
Cheat River (Pool No. 9.)
Slipped Compposed of
Material Water Laden Gumbo and Loose Rocks
Solid Rock
ENG. NEWS.

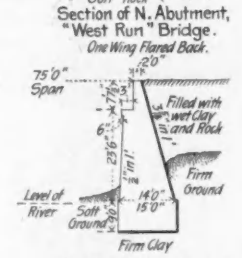
Center Section of North Abutment, Cheat River Bridge.



Section of N. Abutment, "West Run" Bridge.



Section of N. Abutment, Stone's Bridge.



Section of N. Abutment, "Laurel Run" Bridge.

SECTIONS OF ABUTMENTS FOR BRIDGES ON BALTIMORE & OHIO R. R., IN WEST VIRGINIA.

*Abstract of a paper read before the Canadian Society of Civil Engineers.

By the cross-section in the accompanying cut it will be seen that the abutment was designed for 4-10 height plus front batter to the ground line and a pilaster below. On the same plate are cross-sections of a few other abutments built at the same time under supervision of the writer, of good second-class masonry throughout, in which the same rule has been substantially followed. All of these abutments were subjected to unusually severe conditions; all were loaded with wet, heavy material behind, and had weak supports for their pilasters in front, most of them were partly built in the winter season, and all were loaded soon after completion with a running grade, dump, and entirely untamped. Yet they have stood to their work with slight cracks, which ceased in a few days after the severest strains were over.

Theory has wrestled more or less successfully with the design of earthwork retaining walls; and as it has not positively determined any one of the three conditions necessary to a successful solution of the question, namely, the amount of thrust, its direction, and point of application, it is most interesting to know, not so much that an abutment has stood the test of time, but that it is as nearly as possible the most economical structure for fulfilling a given duty. Some one has said that: "Those are poorly designed culverts on a line of railway in which not even an occasional one at widely separated intervals has failed to carry the rainfall." And in the same way, although not arguing to the point of failure, those are poorly designed abutments that are so needlessly strong as to be far above their requirements at the moment of greatest strain, which moment is when the cement is not fully hardened and the embankment is settling rapidly and is full of moisture. Never again will such a structure be called upon for so great a load as in the first few days or weeks after the embankment has been built.

The piers were built on timber cribs sunk to a firm foundation by dredging. The masonry was first-class ranged rock work, laid in courses not less than 12 ins. thick.

The cement used was the Louisville Black Diamond, a very good natural cement, if used when fresh, but deteriorating rapidly with age. It is of a dark slate color, very uniformly ground, has no noticeable free lime, and will stand 45 to 60 lbs. in 24 hours. It was shipped in paper bags, which saves about 20 cts. per bbl., and costs $1.10 per bbl. delivered in Morgantown, W. Va., on cars. Ordinary mortar was mixed 1 cement, 2 sand, and kept continually and thoroughly tempered on the wall until a box was used up. As this is a quick setting cement, this was very necessary, and experiments lately made in Ohio (Engineering News, Jan. 5, 1893) show that cement so tempered does not lose much strength for one or two hours, but if tempered for a long time, say, eight hours, will reduce its strength about 80% at end of one week, and 40% at the end of seven weeks.

The concrete in abutments was mixed 1 cement, 2 sand, filled with stone, broken to pass a 2-in. ring. The mortar was made as usual, by mixing cement and sand thoroughly before adding water, and then thoroughly mixing again before adding the stone. This is particularly mentioned, because most contractors (because it is cheaper) and even some engineers, make concrete by putting down alternate layers of sand, cement and stone dry, and then add water, and mix by repeated turnings over. This the writer does not consider will blend the sand and cement so thoroughly as in the first method, or give as good results. The concrete was then put down in 9-in. layers, and rammed with a 2-man rammer, until water stood on the surface.

The timber work was commenced Aug. 29; masonry work commenced Sept. 24, 1892; suspended Jan. 10 to March 1, 1893, owing to river being frozen, and completed April 30, 1893, or a total of 167 working days, in which time was built:

367	cu. yds. of	timber,
250	" "	concrete,
3,710	" "	masonry,
4,327	" "	Total,

of which all but the concrete was laid by one gang, or at an average of 25 cu. yds. per day, including all stoppages from rain and other incidents. On one occasion 200 cu. yds. were laid in 48 hours, working 12-hour shifts. The cost of the structure was as follows:

4,327 cu. yds. masonry, timber and concrete	at	$11.00	$47,597
2,085 cu. yds. riprap	"	2.50	4,652
2,085 " " dry earth excavation.	"	.50	1,042
179 " " dry rock excavation..	"	1.00	179
1,776 " " wet excavation.....	"	2.00	3,553
Superstructure, estimated cost $33,000.....			33,000
Total			$90,023

The contract price given for masonry in the above table included all dredging, cofferdams, pumping, bailing, timbering, cement, sand, and every other expense connected with construction of the work, except excava-

tion of foundations, as noted in same table, wet excavation being considered as all material below pool. There were 1,930 bbls. of cement used, out of which about 300 bbls. were used in concrete, leaving 1,630 bbls. for masonry work proper. Allowing 130 bbls. as wasted or condemned, which is above the mark, leaves 1,500 bbls. for 3,710 cu. yds., or 4-10 bbl. per cu. yd.

STAND-PIPE ACCIDENTS AND FAILURES.*

By Prof. Wm. D. Pence.

(Continued from p. 277.)

Cincinnati, O., June 29, 1881.

The Price Hill tank at Cincinnati, O., burst at 10:30 p. m. on June 29, 1881, while being filled for the first time. It was 100 ft. in diameter and 48 ft. high and its capacity to the proposed 46-ft. overflow level was 2,700,000 gallons. The tank had been completed in the fall of 1880, but no test was put upon it until June 17, at which time water was

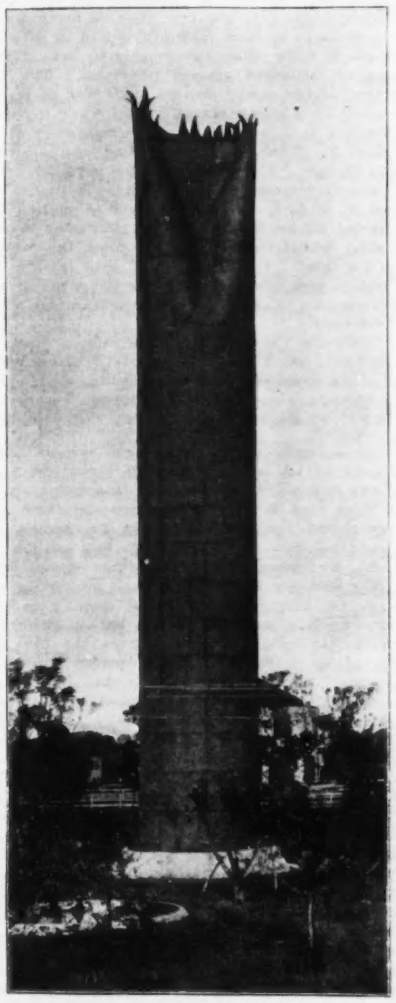


Fig. 1. Front View of Collapsed Stand-Pipe, Victoria, Tex.

first admitted. In the course of twelve days the water had reached a depth of 39½ ft., when the initial rupture occurred at a point 12 ft. from the bottom of the tank.

The tank consisted of twelve courses of plates, of 4 ft. each, the thicknesses of which were:

Bedplate, ⅜.

Course.	Thickness, ins.	Course.	Thickness, ins.
1	⅝	5	⅝
2	9-16	6, 7	5-16
3	½	8 to 12	¼
4	7-16		

Single lap-riveting was used in all horizontal seams and in the bedplate. The vertical joints were abutted, strapped and double-riveted in the lower six courses, and in the upper half they were double lap-riveted. The 4×6×¾-in. bottom angle joined the sides and the bedplate of the tank by one and two rows, respectively, of 15-16-in. rivets. Internal stiffening channels and angles were used in the upper courses, they having been added in a supplementary contract.

The plate-metal was required to show by tests of samples from each plate a minimum tensile strength of 65,000 lbs. per sq. in., but no reference to ductility was made. All test pieces met requirements and the records show ultimate resistances of from 71,000 to 90,000 lbs. Test pieces taken from the ruptured plates after the accident showed an ultimate strength of from 70,120 to 75,200 lbs.; an elastic limit of from 39,727 to 44,300 lbs. per sq. in.; and a reduction in area of from 31.4 to 46.5%.

The break started at the top edge of the third course at the junction of the abutting plates of the fourth course, and a fragment 48 ft. long by 24 ft. high burst out and was projected about 100 ft. The lines of fracture extended from this aperture through both solid plate and riveting, obliquely to the top and vertically downward to the bottom angle. The remainder of the side plates were torn loose from the bedplate, the line of rupture being along the bottom row of rivets in the ⅝-in. plate, and were hurled in a connected mass about 150 ft. in the opposite direction. In the judgment of Mr. A. G. Moore, who took charge of the work as superintendent and engineer upon the completion of the eighth course, the accident was "due to Bessemer steel plates, which, although possessing high tensile and fair ductile properties, would not withstand the aggravation of the excessive and continuous distortions which were caused by the prevalent high winds during its construction, which extended through many months."

References.—Cincinnati "Commercial," June 30, 1881. Engineering News, Vol. VIII., pp. 278-9 (July 9, 1881). Van Nostrand's Engineering Magazine, Vol. XXV., pp. 330-2 (October, 1881). Cincinnati Water Department Report, 1881. Engineering & Building Record, Vol. XVII., pp. 289-90 (April 14, 1888). Proceedings American Water-Works Association, 1888, p. 106. Engineering & Building Record, Vol. XVII., p. 337 (May 12, 1888). Engineering News, Vol. XX., p. 272 (October 6, 1888). Manual American Water-Works, 1889-'90, p. 364. Correspondence with Superintendent and Engineer Cincinnati Water-Works Department (1893).

Lexington, Mo., June 22, 1885.

The wrought iron stand-pipe at Lexington, Mo., fell on June 22, 1885, when full of water during its first test. The structure consisted of a tank 22 ft. in diameter by 100 ft. high supported upon six columns 50 ft. high, making the total height 150 ft. These columns were cylindrical in form, made of boiler plate, the five outer ones being 36 ins. and the one center column being 42 ins. in diameter. They were tied together with 2-in. rods and the tank bottom rested upon an I-beam floor system. The foundation under each column consisted of a 5×5×5-ft. concrete footing with a cap of soft stone. The inlet pipe was supported by connections with one of the columns. The flange connection in the tank bottom leaked badly and it is believed that the water running down the column undermined the insufficient footings. At the time of the accident no cause for it was made public, but information from a credible source establishes the fact that the failure was due to deficient foundations. The destruction of the stand-pipe was complete.

Descriptions of this accident heretofore published seem to have been based upon the press account, which was grossly in error in several important particulars.

References.—St. Louis "Globe Democrat," June 23, 1885. Engineering News, Vol. XIII., p. 413 (June 27, 1885). Proceedings American Water-Works Association, 1888, p. 106. Engineering & Building Record, Vol. XVII., p. 337 (May 12, 1888). Engineering News, Vol. XX., p. 272 (Oct. 6, 1888). Manual American Water Works, 1889-'90, p. 559. Correspondence with the contractor (1893).

Caldwell, Kan., June 11, 1886.

The 12×150-ft. steel stand-pipe at Caldwell, Kan., while in course of construction, was blown down by a cyclone during the night of June 11, 1886. The wind blew from the northwest and the guys giving way, the structure fell toward the southeast. No water had been pumped into it at the time of the accident. Although the structure partially collapsed in falling the damage to it was not serious. After cutting out the rivets and rebending the plates the stand-pipe was rebuilt by using the same material. No indications of weakness have since been observed.

References.—Proceedings American Water-Works Association, 1888, p. 106. Engineering & Building Record, Vol. XVII., p. 337 (May 12, 1888). Engineering News, Vol. XX., p. 272 (Oct. 6, 1888). Correspondence with the Superintendent Caldwell Water Co. (1893). Correspondence with the contractor (1893).

Victoria, Tex., Aug. 20, 1886.

On Aug. 20, 1886, during a severe hurricane, the upper portion of the 16×100-ft. wrought iron stand-pipe at Victoria, Tex., failed by collapsing. The structure was only partially full, the water level being 30 ft. below the top at the time of the accident.

The thickness of the plates was ½ in. for the first 70 ft. and 3-16 in. for the remaining 30 ft. Only the section of thin plate, which was empty, gave way and the collapse occurred on the windward side of the structure. The top edge was stiffened by an angle iron and the stand-pipe was anchored to the foundation by means of brackets.

This accident occurred on the second day of the great gulf coast storm of August, 1886. No gaged observation of the velocity of the wind at Victoria

Fig. 2. Side View of Collapsed Stand-Pipe, Victoria, Tex.

was taken, but it was estimated at 80 miles per hour. The maximum gaged velocity at Galveston was 53 miles per hour, but at Indianola, which was almost totally destroyed, the velocity, at daylight on Aug. 20 had reached 72 miles per hour, when the signal station building blew down, killing the observer. At Seguin, Tex., not far from Victoria, the velocity was estimated at 85 miles, and at San Antonio, 80 miles per hour.

While at the time of this accident to the Victoria stand-pipe it was believed by some that the collapse had been largely due to the formation of a partial vacuum in the empty portion at the top, the fact that the yielding was on the windward side indicates that the cause is to be traced only to the direct impact of the wind. The empty portion swayed to and fro and vibrated very perceptibly before collapsing. The use of needlessly thin plates in the upper portion of the structure was plainly the chief cause of the failure, for the coincidence of an

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empty stand-pipe during a storm of unusual severity should have been provided for as a probable critical condition. Fig. 1 is a front and Fig. 2 a side view of the collapsed structure.

References.—U. S. Monthly Weather Review, August, 1886, pp. 210-11. Scientific American, Vol. LV., p. 264 (Oct. 23, 1886). Sanitary Engineer, Vol. XIV., p. 616 (Nov. 27, 1886). Proceedings American Water-Works Association, 1888, p. 106. Engineering & Building Record, Vol. XVII., p. 337 (May 12, 1888). Engineering News, Vol. XX., p. 272 (Oct. 6, 1888).

Gravesend, N. Y., Oct. 7, 1886.

The stand-pipe of the Kings County Water Supply Co., located at Gravesend, L. I., burst at 1 p. m., Oct. 7, 1886, while undergoing a preliminary test. In view of the numerous accounts of this accident heretofore published, only the more important features will be here presented.

The Gravesend stand-pipe had a total height of 250 ft., which made it the tallest structure of its class yet built. As usually described, it consisted of a lower and an upper cylinder, 16 × 70 ft. and 8 × 155 ft., respectively, connected by a conical frustum 25 ft. in height. To be exact, however, it should be stated that the lowest section was also a conical frustum, having diameters of 16 ft. and 14.4 ft. at the bottom and at the 70-ft. level, respectively; for it was specified that "for the first 70 ft. the course will be all inside, so at that height the diameter will be lessened by the thickness of the plates. In the taper, the course will be all inside, and above that they will be large and small." A photographic view of the stand-pipe, taken during construction, plainly indicates that the plates were arranged as specified, causing the reduction in diameter above mentioned. Special reference to this condition seems proper in connection with the much-discussed upward thrust due to hydrostatic pressure on the conical surface, which is generally believed to have led to the failure. The relative effect of this reduction in the bottom section, however, was not great.

It is stated that the stand-pipe had previously been filled, when the bedplate was observed to be slightly lifted up about the edges. To counteract this tendency, two sets of braces of 24 each were inserted, being attached to the second courses of plates at 6 ft. and 8½ ft. from the base, respectively. These braces were 2½ × 1 in. in section and were bolted to the bedplate and riveted to the sides, leaving about 1½ sq. in. net section.

At points 104 ft. and 224 ft., respectively, above the base, ⅜ × 8-in. welded collars were placed, from each of which six 1-in. wire rope guys extended to anchors located 80 ft. and 150 ft., respectively, from the stand-pipe. A top angle, 3 × 3 × ¼ in., was used and stiffening Ts were placed in the topmost five courses and at the two extremities of the middle frustum.

The plates consisted of ordinary tank steel and the only requirement specified was that "all plates will be steel, stamped 60,000 lbs. tensile strength." It is stated that a number of plates were rejected by the contractor as being defective, although several defects, whose existence must have been previously known, were found in the ruins. The thicknesses of the plates, of which there were 50 5-ft. courses, were as follows, the bedplate having been ⅞ in. thick:

Course.	Thickness, ins.	Course.	Thickness, ins.
1	⅞	27 to 33	⅝
2 to 6	¾	34 to 39	5-16
7 to 20	⅝	40 to 45	¼
21 to 26	½	46 to 50	3-16

The vertical joints were triple-riveted in the first eight courses and double-riveting was used in the remainder of the vertical as well as in all the horizontal seams.

At the time of the accident pumping had been in progress two hours and the water had reached a height of 227 ft., giving a pressure of nearly 100 lbs. per sq. in. at the base. Although it has been claimed that the initial rupture took place in a defective plate in the 14th course, the statement of eye-witnesses that the stand-pipe burst in one of the lower courses seems more credible. Assuming such to have been the case, the rupture seems to have been due to a local defect, since the unit stresses were not dangerously large at any point. A very plausible theory has been advanced which attributes the failure to the unequal distribution of the upward thrust among the inside braces and the rupture of one or more of them under an excess of strain. While ample provision for the upward tendency might have been made in the original plans, had consideration been given the matter, the design as a whole has justly been pronounced absurd.

References.—Engineering News, Vol. XVI., pp. 255, 264 (Oct. 16, 23, 1886). Sanitary Engineer, Vol. XIV., pp. 494-6, 547 (Oct. 23, Nov. 6, 1886). Scientific American, Vol. LV., pp. 390, 405 (Dec. 25, 1886). Proceedings American Water-Works Association, 1888, p. 106. Engineering & Building Record, Vol. XVII., p. 337 (May 12, 1888). Engineering News, Vol. XX., p. 272 (Oct. 6, 1888). Journal New England Water-Works Association, 1893. Engineering Record, Vol. XXVII., p. 216 (Feb. 11, 1893). Engineering News, Vol. XXIX., p. 243 (March 16, 1893).

PERSONALS.

Mr. W. E. Gates has been elected City Engineer of Marietta, O.

Mr. F. L. Buford has been elected City Engineer of Beaumont, Tex.

Mr. Cary A. Wilson, Chief Engineer of the Missouri, Kansas & Texas Ry., has been appointed Consulting Engineer.

Mr. Rhoades Fisher, Jr., has been appointed engineer to superintend the construction of the water distribution system of Austin, Tex.

Mr. Joseph Kepferle, formerly Assistant Engineer on the Colorado River dam at Austin, Tex., has been placed in entire charge of the work, in place of the late Mr. Gorham P. Low.

Mr. Nathan P. Towne, Chief Engineer, U. S. Navy, has resigned from the navy, in order to accept a position in the engineering department of the Cramp Shipbuilding & Engineering Co., of Philadelphia, Pa.

Mr. John F. Easterbrook has been appointed Western Manager of the White-Crosby Co., electrical engineers and contractors, with headquarters in the Rookery Building, Chicago. He was formerly engineer of the Chicago Edison Co., and for two years has been Chief Engineer of the South Chicago Electric R. R. Co.

Mr. Edwin Darling has retired from the position of Superintendent of the waterworks of Pawtucket, R. I., after 14 years of service. Mr. Darling resigned some months ago, owing to ill health, but before his resignation was accepted by the Board of Water Commissioners, the duties of the latter were merged with the Board of Public Works, so called, of which it is stated that Mr. Loren G. Ladd is the sole member. Mr. Darling is well known among the water-works engineers and officials of the country.

Mr. Joseph H. Paddock, Chief Engineer of the Frick Coke Co., was murdered by the strikers at the Davidson works at Connellsville, Pa., April 5. He had just come out of the mine with his instruments and was in the coal tipple when it was attacked by a mob of the Hungarian strikers. Mr. Paddock was clubbed and stoned to death and his body thrown from the tipple to the coke ovens 40 ft. below. He was 39 years of age, a graduate of Lehigh University, and had been with the company for eight years, and before that time was Resident Engineer on the Pittsburg, McKeesport & Youghiogheny R. R. He leaves a wife and children.

Mr. Jablochkoff, the famous electrician and inventor of the Jablochkoff electric lamp, died in Saratoff, Russia, April 6. He was an officer in the Russian army, when in 1876 he invented one of the earliest successful practical electric lights, known as the Jablochkoff candle. In 1877 it was publicly introduced in one of the great shops of Paris, and afterward in some of the streets of that city. The device consisted of two flat strips of carbon placed vertically side by side and about ⅛-in. apart, the space between them being filled with some insulating substance like kaolin or gypsum. The current was made to ascend one of the rods, leap across the insulating substance and descend the other rod. The invention attracted much attention at the time of its first application, but was soon superseded by more economical forms of arc light.

NEW PUBLICATIONS.

APRIL MAGAZINES.—In the "Century" Col. Geo. E. Waring, Jr., has an excellent paper on "Methods of Sewage Disposal," intended, of course, for the popular reader rather than the engineer, but not without interest to the professional reader who would find a summary of the principal facts concerning this important field of engineering in a small space. Doubtless the chief value of such articles to the profession, however, is the work they do in educating the public to an appreciation of the engineer's services. It has been said with reference to another branch of engineering that the public is not willing to pay for the best the engineer can do. This is unfortunately true, but the more the public is educated and instructed by such papers as this of Col Waring's, the greater will be the demand for the highest class of work of which the engineer is capable. Among the "Open Letters" we find an interesting summary of the progress of forestry in the various countries of Continental Europe, from the pen of Mr. B. E. Fernow.

"Harper's" opens with a realistic account of a naval battle between the U. S. line-of-battleship "Farragut" and a battleship of a European Power. The engagement is supposed to occur in or about the year 1898, and ends, of course, in the victory of the U. S. vessel. Most of the paper is really devoted to a description of the "Farragut" herself and her armament, and gives a very fair idea of a modern armored battleship of the first class. Prof. Arthur T. Hadley writes on "Yale University," including in his article an excellent though brief account of the Sheffield Scientific School.

In "The Forum," Col. Aldace F. Walker discusses the question, "Has the Interstate Commerce Law Been Beneficial?" and a clearer and more interesting statement from so good an authority has nowhere appeared. The article should be read carefully by every one interested in this question. We can only say here that Col. Walker holds that the law "has in many ways been beneficial to business interests, but in its present form there is little value now remaining bevond the assertion of important general principles." The establishment of the commission he holds was an error, but the law itself was a necessity, and while it needs amendment, it is in nowise likely to be done away with.

Dr. Geo. F. Shrady describes "American Achievements in Surgery," a department of the physician's art which almost deserves to be classed as a branch of engineering, in view of the importance of modern inventions and mechanical ingenuity in influencing its development. Mr. Herbert Welsh describes the "Conference for Good City Government," held recently in Philadelphia, and briefly summarizes the steps necessary in reforming existing city governments which were there laid down.

In "Scribner's" is an illustrated account of work in a diving dress, which will be of interest to every engineer who has ever had to do any submarine work.

THE INTERNAL WORK OF THE WIND. By S. P. Langley. Washington: Smithsonian Inst. 4to; pp. 28; 5 plates.

Professor Langley in this monograph records some experiments of his own, made with very light anemometers recording at frequent intervals, which clearly show that in all Northern latitudes there are very great and frequent momentary fluctuations in the wind's velocity; and the experiments go far to prove the conclusion which the author himself accepts, that such pulsations are always present in all winds, of the temperate regions at least. As explaining why this may and should be so, Professor Langley points out with great force that the air is very nearly a frictionless and perfectly elastic fluid, and that if it were perfectly so any motion once impressed upon it would be preserved for ever. The general line of his argument might have been indicated by an analogy with the ceaseless undulations of the ocean's surface, due to the broad fact that friction is not able to destroy the energy imparted to the water by the winds as fast as it is imparted to it, unless the waves are of considerable amplitude and are practically universal and unceasing. Air being so much more nearly frictionless and so highly elastic, it is reasonable to suppose that wave-like disturbances of the uniformity of its motion may be of much greater amplitude and persistence.

From this point of view, which is in large degree a new one, it seems not unreasonable to suppose that even the vast masses of the trade winds, which flow so smoothly and steadily over the ocean, and are so free from all immediate causes of local disturbance, may also be filled with such pulsations; but that fact remains to be proved, and is by no means to be taken for granted. Granting that the winds of Pittsburg and Washington, and of all other parts of the north temperate zone, are never steady, but always made up of irregular pulsations, it by no means follows that the great earth currents of the tropics are, and it is in these districts that the true soaring birds most abound. The north temperate zone is the very empire of fickle winds, and the same causes which make them so as a whole might well make them exceptionally irregular in detail. If so, the further fact, that true soaring birds are less abundant in this zone than in the tropical zone, and in both are less abundant on land than at sea or at great altitudes above the land, would go far to disprove the very theory that Professor Langley advances, viz.: That birds which soar at will on motionless wings do so by taking advantage of these internal fluctuations of the wind.

Professor Langley is, of course, perfectly sound in his conclusion that if these internal fluctuations always exist in the wind, they make it dynamically possible for an animal or other mechanism to soar

as birds do, and solely by availing itself of this internal potential work. Before this theory can be accepted as anything more than a working hypothesis, on which to base further investigation, however, two fatal gaps in it must be closed. It must be shown, first, that such fluctuations of considerable amplitude are always present in all winds frequented by soaring birds, including the great wind currents of the tropics, where they most abound, and it must be shown, secondly, that the actual maneuvers of soaring birds are such as this theory calls for, and more consistent with it than with any other theory which is dynamically adequate.

We apprehend that considerable difficulty will be encountered in establishing either one of these propositions, and especially the latter. The first may be very easily investigated by transporting Professor Langley's apparatus to some one of the West India islands, say, where soaring birds abound, where the land is low and other causes of local disturbance few, and where the trade winds blow as steadily as elsewhere for weeks together. A single day's observation under these conditions would establish or refute the first proposition, and the Smithsonian Institution could hardly make a more useful contribution to knowledge than by aiding or carrying through such a decisive investigation.

Until this has been done it is not worth while to discuss the second proposition. The necessary basis of fact has not been laid. But there are three facts which seem to us to militate strongly against the soundness of Professor Langley's conclusions as to soaring flight, even if his conclusions as to the internal status of the wind be established as broadly true: (1) It is not necessary to assume any irregularity in the wind to explain soaring flight dynamically, and in a simpler way. (2) The actual maneuvers of soaring birds do not seem to correspond with those which the pulsation theory of soaring requires. (3) They do seem to correspond with an entirely different theory.

THE WATER SUPPLY OF PITTSBURG AND ALLEGHENY; Report of the Joint Commission of the Chamber of Commerce of Pittsburg, Engineers' Society of Western Pennsylvania, Allegheny County Medical Society and Iron City Microscopical Society on the Present Condition and Improvement of the Water Supply of Allegheny County. 8vo, paper; pp. 131; tables and five diagrams.

This pamphlet contains the reports of a sub-committee on protection, pollution and disinfection and another on possible sources of supply and various means of purification, both of which reports were approved by the general committee. After these reports are papers by individual members, for which the commission does not hold itself responsible, as follows: "The Disposal of Sewage," by T. P. Roberts; and also "Sedimentation as a Process for the Purification of Water," by the same author. "The Water Supply of Allegheny," by Prof. F. C. Phillips; "Hygiene of Public Water Supply," by Dr. Eugene G. Matson; "Sand Filtration," by Gustave Kaufman; "Mechanical Filtration," by Samuel Diescher; "Project for a Water Supply for Pittsburg and Allegheny," by Charles Davis; "Possible Sources of Water Supply by Gravity," by James H. Harlow; "Prevention of Waste in the Water Supplies of Pittsburg and Allegheny," by Geo. S. Davidson. All the authors named above, except Professor Phillips and Dr. Matson, are cited as civil engineers.

About 50 of the 131 pages of this pamphlet are occupied by the paper by Dr. Matson on the "Hygiene of Public Water Supply," which is a valuable contribution to the subject. Some of the views expressed in the other papers are hardly in accord with the most recent investigations on the subject, but considered as a piece of disinterested work, undertaken by a group of men with the purpose of conserving the health and general welfare of their respective communities, the whole pamphlet is a production worthy of high praise.

DYNAMO AND MOTOR BUILDING FOR AMATEURS. With Working Drawings. By C. D. Parkhurst, Lieut. Fourth Artillery, U. S. A., Assoc. M. Am. Inst. Elec. Engrs., New York: The W. J. Johnston Co., Ltd. 12mo; pp. 163; illustrated; $1.

In issuing this work the author assumes that the amateur, to whom it is addressed, is fairly well acquainted with the use of the necessary tools and with the principles of electrical science. Thus equipped, the directions given will enable him to construct the simpler types of motors and dynamos, machines which will give fairly efficient results as a return for the outlay of money, time and patience. The author has here endeavored to simply point out the main features to be observed, plainly and with clear illustrations, leaving it to the amateur to vary the methods in detail as his knowledge of the principles here laid down will permit. But while primarily intended for the amateur, the detailed information on armature windings, connections and currents, and the description of the design of a 50-light dynamo, will be found useful by many electricians. Clear, concise descriptions and working drawings are given for the construction of the following machines: A small bi-polar shuttle armature motor of simple construction, capable of driving a small ventilating fan with current from a primary battery. A small motor for driving a sewing machine, for which no castings or patterns are needed. A sewing machine motor of more finished appearance and of greater efficiency than the above, being of a regular factory-made type. A dynamo of modern type, capable of lighting 50 16-c. p. lamps of 125 volts. In an appendix, data of some high-class dynamos and motors are given which will be of assistance as guides should the amateur wish to design any other types than those treated in the book.

SURVEYING AND SURVEYING INSTRUMENTS.—By G. A. T. Middleton. London, Whittaker & Co.; New York, Macmillan & Co.: 8vo; pp. 116; illustrated. Price, $1.25.

This book treats of English instruments and English methods of practice, and for all distances uses the Gunter's 66-ft. chain. It describes in a rather elementary way various instruments for surveying and leveling, and the mode of using them. The dumpy level is said to be preferred to the Y level by the practical worker in the field, as it has fewer loose parts and is more easily adjusted. The transit is rightly said to be a much more complete instrument than the theodolite, and the author states that theodolites generally have two diagonal cross-hairs and a horizontal hair, using no vertical hair. For measuring distances the tacheometric theodolite and the omnitelemeter are described, but there is no mention of ordinary stadia work. The illustrations are rather poor and badly printed. The typography is otherwise good, and the book is small and compact in accordance with the very commendable practice of English publishers of technical books.

TRADE PUBLICATIONS.

JACKS.—Watson & Stillman, New York. 8vo; pp. 37.

Among the various types of jacks described in this catalogue are hydraulic, claw and lifting jacks of various patterns, and special jacks for pipe joints, transfer pits, etc.; also ratchet and traversing jacks. Instructions are given for operating and repairing hydraulic jacks.

CATALOGUE OF THE WESTINGHOUSE AIR-BRAKE CO. January, 1894. Pittsburg, Pa.

This new edition, designed to take the place of the 1890 catalogue, is strictly what it purports to be, a catalogue proper, without any explanatory text. It is arranged primarily to facilitate ordering, and for the use of employes having occasion to order air-brake supplies, and to such it is sent on application. Explanations of the brake plant must be sought in other publications, but the drawings of this catalogue are so clear and full as to be in themselves an explanation to any one having a general knowledge of the plant who studies them with care. A striking feature is the multitude of different engine brake cylinders and details, no less than 27 different vertical cylinders alone; and there are also four different types of horizontal cylinders, which are each furnished of a dozen or twenty different sizes.

ALUMINUM. The Pittsburg Reduction Co., Pittsburg, Pa. Pamph.; pp. 47.

This is one of those admirable trade publications, of which so many are issued nowadays, giving a pretty complete summary of the latest technical information in regard to their special field. There is more than usual interest in such a publication on this subject, as intimate knowledge of the properties of the metal is still largely confined to its manufacturers. This pamphlet contains the very latest information, not only as to the pure metal, but as to its alloys and methods of working. As it chances, we have very recently published most of this information in these columns, but otherwise we should almost be tempted to reprint much of this pamphlet. We notice a queer mistake on page 11, where it is stated that the metal's specific heat 0.2185, "means that the quantity of heat which would raise the temperature of any given quantity of aluminum through 0.2185° would raise the temperature of the same quantity of water through 1°." It, of course, means just the reverse of this, i. e.: That only 21.85% as much heat is needed to heat a unit weight of aluminum by any number of degrees, as to heat a unit weight of water the same number of degrees.

SOCIETY PROCEEDINGS.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The regular monthly informal meeting was held at Roanoke March 21. In the absence of Mr. R. P. Patterson, who was to have read a paper on "Blast Furnace Construction," a paper on "Paints" was read by Mr. Samuel Wallis. The next informal meeting will be held April 18, the subject for discussion being "Blast Furnace Construction," opened by Mr. R. P. Patterson. Alternative subject, "Boiler Construction," opened by Mr. G. R. Henderson.

J. A. Pilcher, Secy.

AMERICAN METROLOGICAL SOCIETY.—The annual meeting will be held in Washington, D. C., at 2 p. m. on Friday, April 20, at the Columbian University. Mr. T. C. Mendenhall will report on the International Electrical Congress at Chicago, and Mr. A. A. Michelson will give an account of his work at the International Bureau (near Paris) in determining the value of the meter in terms of wave lengths of light. The committee on color standards will make an interesting report. All persons interested are invited to attend the meetings. Mr. J. K. Rees, Columbia College, New York city, is secretary.

BOSTON SOCIETY OF CIVIL ENGINEERS.—The annual meeting was held on March 21. Ten new members were elected. The annual reports of the board of government, the secretary and the treasurer were read, from which it appears that the present membership of the society is 322, a net gain of 12 during the year. Eleven meetings were held during the year with an average attendance of 86. A net increase of $581 in the funds of the society was reported. The election of officers resulted as follows: President, William E. McClintock; vice-president, Henry H. Carter; secretary, S. Everett Tinkham; treasurer, Edward W. Howe; librarian, Henry F. Bryant; director, Frank O. Whitney. Mr. William E. Foss read a paper in which he presented some new modifications of formulas for the flow of water in pipe and channels. Mr. George Bowers, City Engineer of Lowell, gave an account of that city's experience in obtaining a supply of water from driven wells. Mr. Bowers exhibited a large number of photographs illustrating the work, and also showed the screens used. The next meeting of the society will be held on April 18. Mr. Wm. B. Fuller will read a paper on "Street Grades and Intersections."

S. E. Tinkham, Secy.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF MINNEAPOLIS.
April 16. Secy., E. Nexsen, 504 Kasota Block.
WESTERN RAILWAY CLUB.
April 17. Secy., Clement F. Street, Rookery, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
April 17. Secy., F. W. Hart, Washington, D. C.
BOSTON SOCIETY OF CIVIL ENGINEERS.
April 18. Secy., S. E. Tinkham, 36 Bromfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
April 18. Secy., J. A. Pilcher, Roanoke, Va.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
April 18. Annual meeting at Niagara Falls, June 20. Secy., F. Collingwood, 127 E. 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
April 18. Secy., Wm. H. Bryan, Turner Bldg.
NEW YORK RAILROAD CLUB.
April 19. Secy., John A. Hill, Temple Court.
ENGINEERS' CLUB OF CINCINNATI.
April 19. J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
April 19. Secy., Howard Berge, 100 Washington St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 19. Secy., S. A. Charpiot, Macon, Ga.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
April 19. Secy., Daniel Carhart, Carnegie Lib. Bldg., Pittsburg.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
April 19. Secy., C. H. McLeod, Montreal P. Q.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
April 20. 201 Washington Building.
ENGINEERS' CLUB OF PHILADELPHIA.
April 21. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
April 21. Secy., P. Valentine. At 231 Union St., Brooklyn, and 616 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.
DENVER SOCIETY OF CIVIL ENGINEERS.
April 24. Secy., F. E. King, Jacobson Block.
CENTRAL RAILWAY CLUB.
April 25. Secy., S. W. Spear, Buffalo, N. Y.
WESTERN SOCIETY OF ENGINEERS.
May 2. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
May 4. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
May 4. Secy., O. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
May 7. Secy., C. L. Annan, City Engineer's Office.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 8. Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILWAY CLUB.
May 8. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
May 8. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
May 9. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
May 9. Secy., F. M. Curtis, P. O. Box 1576, Boston.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 9. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 10. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
May 10. Secy., G. W. Shaw, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
May 11. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
May 12. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
May 14. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
May 14. Secy., M. F. Schinke, City Hall, Milwaukee.
MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.
MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

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We feel unwilling to pass over so sad an event as the sudden death of Mr. Edward B. Wall, chronicled by us last week, without something more than the usual formal notice then given. His career was in many respects as remarkable as it was brief, and he deserves to be held in lasting remembrance for one conspicuous public service, if for no other, the leading part which he took in getting and keeping the Master Car Builders' Association in the straight and narrow path on the car coupler issue, the full importance of which service is not even yet realized, and in fact can never be apparent on the surface, because it is hard to appreciate and impossible to estimate accurately the dangers from which we have escaped. There was at one time great danger that we should flounder along for an indefinite number of years in a state of confusion more confounded; with legislatures commanding that something be done, and without any unity of action as to what that thing should be, partly because of honest differences of opinion and partly from pig-headedness and interested motives. To Mr. Wall, more than to any other man, belonged the credit of averting this calamity, his chief coadjutors being two or three other young men who were, or had been, in the Pennsylvania service. He took from the first the correct view of the proper course, as it has since proved, and by skillful argument and good generalship, so guided the course of events that, when looked back upon, there is little to regret, either of haste or delay. In this he was but displaying those personal qualifications which in other ways made him a marked man from his youth and led to his exceptionally rapid advancement in the Pennsylvania service. A certain resemblance to Napoleon in his face and figure was often remarked upon and was quite noticeable, and the resemblance seemed to extend also to certain natural qualities of leadership and a certain quickness and clearness of mental action. He was still young when death so suddenly ended his work, and therefore his career was still great in promise, for he was the kind of man who might reach almost any degree of prominence.

The work of assessing the value of all the railway property in Texas which has been undertaken by the Railroad Commission of that state, as noted in our news columns, is, so far as we recall, unique in the history of railway commissions in this country. Its object is, of course, to obtain a valuation of such property upon which rates can be based and the capital and indebtedness of railway companies can be limited, Texas being now zealously engaged in the work of rate regulation, which began with the granger legislation of a dozen years ago in Wisconsin and has gradually worked southwest through Iowa to the Gulf. From the fragmentary information which has been made public regarding the methods of carrying out this assessment and the bases which are being used in making the necessary estimates, it is not easy to say how reliable the figures will be as indices of the value of railway property in Texas. Even supposing them to be fairly accurate, however, their fairness as a basis upon which to establish just rates will depend largely upon the discretion with which they are used by the rate-making powers. Admitting the justness of the plea that the public should not be required to pay dividends, in the way of increased rates, upon a large amount of "watered" stock, not representing any capital actually expended, there are three ways of estimating the probable cost of a railway. These are (1) to take the account of stock and debt and make deductions for the amount not paid in cash; (2) to estimate directly the probable cost of duplication of such a line; and (3) to take another road as near like it as possible, which is admitted to have been honestly managed, and see what the cost has been in that case. Of the three ways the last is by far the fairer, but it can seldom be applied. The first two methods give results much too small; the first because we can rarely make allowances for earnings which have been expended in construction, and the second because it takes no account of the incidentals, which form an enormous item in any large undertaking. It is impossible to adapt railways in advance to the exact use which is afterward made of them and the changes necessitated by time form an item which in fairness ought to be reckoned as a part of the cost. That $17,060 can represent fairly the money invested per mile of the average Texas railway which is entitled to an annual return to the investors seems doubtful, notwithstanding the cheapness of railway construction in this section of the country; and any general schedule of rates based upon figures obtained in this manner is bound to meet with strenuous opposition from the railway companies.

The meteorological observations at Cornell University, recorded in another column, have already developed one interesting phenomenon, which is confirmed by observations of Prof. S. P. Langley at Allegheny Observatory, recorded in a publication of the Smithsonian Institution, which is also reviewed in this issue. In both cases specially light and delicate anemometers were used, and in both cases they appear to indicate very frequent and large fluctuations in momentary velocity, rising as high as 60 miles per hour, when the ordinary anemometers, recording every mile of wind travel only, will show an average of some 20 miles per hour only. It appears entirely possible that such fluctuations may occur, and it is reasonable to suppose that when special causes combine to aggravate the tendency to gustiness, as they do at most bridges, these occasional gusts may sometimes cause or hasten bridge failures, as notably at Ashtabula. But there are sources of possible error in such observations by anemometer which will forever make it impossible for them to "settle" any such issue, unless confirmed by some other and different mode of test. For instance, nothing could be more natural than that the air should be filled with rhythmic pulsations of varying amplitudes, precisely like the sound vibrations of various kinds with which it is often filled, except that they are longer. These might easily combine to make the cups spin with great rapidity for a second or two, and then combine to retard it for another brief period, all without the slightest necessary and direct relation to the actual velocity of any sensible mass of air, on the same principle that a fiddler may fiddle down a bridge, if he happens to strike the right notes, or a trotting dog may shake it violently.

The only certain method of measuring wind energy is the direct one of exposing various known areas held by attachments of varying but known strength to the pressure of the wind and observing what, if any, relation is found between the force necessary to detach these areas and various kinds of anemometer records. Why does not some one attempt this? It would be a tedious, but not necessarily an expensive or a difficult, investigation, and it would add to the still deficient data of the true value of wind resistance, if it did nothing else.

We refrain from suggesting details for such an apparatus, because suitable apparatus of many different kinds might be devised, but there is one general method of test which has not, so far as we know, been used, and which would seem to promise better results than any other. Let the exposed area be carried on a truck of suitable weight which slides on a track of increasing inclination backward. This truck should be kept headed into the wind by a suitable vane, which might be beneath the track.

We should then get at least a perfectly uniform or uniformly increasing resisting force, and as a 20-mile wind travels 30 ft. per second, if there are in fact any pulsations in the wind of a second or two's amplitude the truck would keep dancing back and forth every second or two for a considerable distance, and the recording of these movements is, of course, a simple matter. With such an apparatus once perfected, a great variety of collateral tests as to the effect of form and size and continuity of surface could also be made; but the main fact to be determined is, what is the actual variation in pressure exerted on a surface as compared with alleged or apparent variations of velocity as shown by the anemometer? A first necessity for such tests is that the instrument shall be removed as far as possible from the influence of disturbing surroundings, and this would be comparatively easy with the plant we have suggested, which could readily be carried on the top of a tall pole or spire. We do not assert that the very light anemometers are in fact deceptive. They may possibly give perfectly accurate indications. We only say that there are possible reasons why they may be highly deceptive, and therefore that their records alone should not be regarded as "settling" anything.

THE TOPOGRAPHICAL SURVEY OF NEW YORK.

We have lately expressed, and we desire to repeat with all possible emphasis on all proper occasions, our strong disapproval of the effort to abolish or curtail the scope of the Coast Survey as now organized in favor of the Geological Survey or any other department or bureau of the government whatsoever. One strong reason for this, which is in addition to those enumerated in our article of March 29, is that there is work enough for the Geological Survey in its own special field, without trenching upon that which is peculiar to the Coast Survey, and which it has so admirably discharged; that, namely, of making an accurate skeleton of triangulations, which may be filled in later by detail surveys, and of accurately mapping all the details of the coast.

We hold that this work cannot be diverted or scattered among dissociated bureaus without great injury to the public interest, and it is obviously wholly inappropriate to a Geological Survey. We hold also that the function of the Coast Survey should be extended to cover a complete skeleton triangulation of our entire country in addition to the survey of the coasts with which it is now charged. For many weighty reasons it is highly important that this work should be done with reasonable promptitude and a much larger fraction of it has been already done than is generally realized.

The triangulations already completed by the Coast & Geodetic Survey besides covering the whole outline of the coast, include a chain of triangles extending nearly across the continent, a wide belt of triangles covering half or two-thirds the area of the Appalachian region, a large part of California, Nevada and Utah, and several smaller areas. So much has already been done and the work has been so well done, that the same bureau should carry it on to completion.

But the task of filling all this skeleton of triangles with detail topography is an enormously greater one, so great that Congress has wisely provided that, for the present at least, it shall be done only by co-operation with the state authorities, and partially at the expense of the states. For this work

the Geological Survey is well suited by its organization, experience and general purpose, and in co-operation with state authorities it has already completed a superb set of maps of New Jersey, and similar maps of Massachusetts and Connecticut are well advanced. New York, however, is the first large state to undertake a complete mapping of its surface in co-operation with the Geological Survey, and the first series of its beautifully engraved maps we recently noticed. One of New York and vicinity we had mounted forthwith for our own use, as by far the best which exists.

Unless the New York Legislature fails in its duty, this year's appropriation will see the surveys for nearly one-third of the state completed, and to the end that those of our readers who can may exert their influence to have this work continued, as well as for their information on an interesting event of the time, we give the following brief summary of what has been done to date in New York, how it has been and is being done, and what it is proposed to do.

The work was practically inaugurated in 1892, when State Engineer Martin Schenck persuaded the legislature to make an appropriation of $3,000 to be expended by the topographic parties of the Geological Survey in the prosecution of their work in the state. As a result of the encouragement thus given, the Geological Survey expended about $17,000 in that year, making about $20,000 in all, as a result of which nearly 2,200 sq. miles of the area of the state were surveyed and shown on the maps above referred to. Last year this work was continued more vigorously by the appropriation of $24,000 on the part of the state, the government spending $27,000. As a result, eleven topographic parties were busily engaged in field work during seven months of the open season, and mapped about 5,200 sq. miles, covering the whole or portions of 30 separate atlas sheets.

The present State Engineer, Mr. C. W. Adams, is taking as lively an interest in the work as did his predecessor and has had introduced in both branches of the legislature bills making an appropriation of $25,000 for its continuance. If this appropriation is made, the end of this year will see an additional 5,000 sq. miles of the state mapped, making about 16,000 miles of the 50,000, the survey of which will then be complete.

To date there have been mapped in all 11,000 sq. miles at a total cost of about $100,000, of which about $27,000 has been appropriated by the state, the remainder by the government. The cost of this work has therefore averaged about $10 per sq. mile, and as the work has been generally distributed in various portions of the state, the engineers having this work in charge feel no doubt of their ability to complete the map of the remainder of the state at the same rate. Thus, if the state continues to make a uniform expenditure of about $25,000 per annum for the next eight years, the survey and map of the remaining 40,000 sq. miles of the state should be completed.

The fieldwork connected with the making of this map is under the immediate control of the Director of the Geological Survey, and during the past year was performed by ten topographic parties and one triangulation party. The latter was engaged on the location of points in a primary triangulation, from which the topographic parties will start their work. This primary triangulation work does not, in our judgment, properly belong to the Geological Survey, but to the Coast Survey. Nevertheless, if it has not been previously done by the one organization, it must be done by the other, as a basis for its work. It is done with the greatest accuracy, angles being read by large theodolites, the microscopes of which read to 2″, and carefully constructed signals are erected on hills from 10 to 15 miles apart, the positions of which are thus obtained within a few inches. These primary points are marked by large cut granite monuments.

Each topographic party consists of a topographer and two assistants. The topographer, starting from this primary triangulation, determines by triangulation with a plane-table the position and elevation of numerous objects all over the surface of the ground, averaging about one to each square mile, such as church spires, cupolas of prominent buildings, signal flags erected on hill summits and permanent and easily recognized features of the landscape. While this plane-table work is being extended the assistants are traversing every road and path by methods which, though not refined, give sufficient data from which to plot on the scale of the map every bend in the road and every house and stream crossing upon it with substantial accuracy. The assistants also run spirit-level lines over many of these roads, from which bench levels may be determined, to which the later work of making a topographic map may be adjusted. As a basis for this work, the whole state should be, but has not been, covered with a network of the most rigidly precise levels.

This preliminary work completed, the topographer plots on a large field sheet to a scale of 1:45,000, first, the points located by primary and secondary triangulation; to this he then adjusts carefully all the roads traversed, and writes along such as were leveled, and on the triangulation points, their elevation above the sea. He then has a base on which to sketch the topography of the country, averaging about 2½ ins. of surveyed roads and one triangulation point per sq. in. of the map, with at least one or two elevations determined by level. It will be easily seen that with such a network of control on the map there is little possibility of serious error in the sketching. With this basework in his hand, the topographer drives over the various roads and walks from them into the large spaces between the roads, sketching in the courses of the streams and the outlines or shapes of the hills with 20-ft. contours. The topographer sketches these contour lines by adjusting an aneroid barometer, which he carries to the nearest of the base elevations, and noting where each additional 20 ft. of rise is made, indicating on the map where it crosses his path and following its outlines by eye along the adjoining slopes. In this way his aneroid elevations are rarely in error by so much as the contour interval, as he checks every mile or so on instrumental levels. Nevertheless, we consider that the most serious defect of these maps, is that the contour work is too cheaply and therefore too imperfectly done, doubtless in conformity with political necessities. For most practical uses it is accurate enough, but a rich country could well afford to spend more money for more precision.

When these maps are completed in the field, they are redrawn in the office, and then engraved on copper, three plates being used to each atlas sheet, on one of which are indicated the waters, on another the contour lines and on the third all artificial features, as roads, houses and names. Three impressions are then taken from these plates for each printed sheet, blue ink being used for water, brown ink for contours or surface relief and black for the artificial features. The area of the state will be mapped on 258 of these atlas sheets, each of which will be approximately 13×17 ins., and will represent an area of 220 sq. miles. Many of the outer sheets, however, contain only a small fraction of this area.

It is scarcely necessary to point out further the value of such work. Its importance can hardly be overestimated for projecting all kinds of engineering works and town improvements, as well as for individual use, which latter alone fully justifies the small expense. As an individual instance of the value of these maps, President Sweet, of the Albany Board of Water Commissioners, has publicly declared that $6,000 was saved to the city of Albany by the use of the map of the Kinderhook Creek territory. This map was found to be so correct that a preliminary location for a pipe line was planned and many of the preliminary surveys for the preparation of the work of bringing a water supply to Albany were rendered unnecessary. Yet the cost of making this map, with many square miles of surrounding country, was but $2,700.

We earnestly hope that nothing will be allowed to interfere with the prosecution of this much-needed work, which is well suited to the purpose and proper scope of the Geological Survey; but we also suggest that the geodetic work of such surveys or of any surveys of the coast or interior is beyond the proper scope of a Geological Survey, and should either be left or placed in the hands of the Coast Survey. We suggest this in the interest of both surveys, since there is an enormous legitimate field for the Geological Survey which it will only imperil by seeking for too great power and for work wholly unrelated to its purpose, and to the training of its chief officers.

LETTERS TO THE EDITOR.

FLAT TOP SEWERS.

Sir: In your issue of March 29, 1894, I notice an article by Mr. Geo. L. Wilson, St. Paul, describing a sewer with a flat roof, the same being formed by steel beams, and flat intervening arches of brick, which he considers to be a novelty in sewer construction.

The same method of securing head room, when the roof of the sewer comes very close to the street pavement, has been usual in New York City for some years past. Sewers in the following streets are built in that way: Canal St., between West St. and Hudson River, span 16 ft., built in 1885. East Houston St., span 6 ft., built in 1887. Sixth Ave., West Washington Place to Clinton Place, span 6 ft., built in 1887. Twentieth St., overflow at Eleventh Ave., span 24 ft., built in 1888. Eighteenth St., between Tenth Ave. and Hudson River, span 6 ft., built in 1891. Ferry St., between Cliff and Gold Sts., span 5 ft., now being built.

Respectfully,
Horace Loomis,
Engineer in charge of sewers.

Department of Public Works, New York city, April 4, 1894.

THE EXPANSION OF ICE IN STAND-PIPES.

Sir: I note, in your issue of March 22, Mr. G. W. Pearsons' communication regarding the much-discussed cause of the East Providence stand-pipe failure. Mr. Pearsons assumes the expansion of ice to have been the cause of the disaster, while I believe the cause was the expansion of the water in the stand-pipe in the act of congelation.

Trautwine estimates the force exerted at the moment of freezing as not probably less than 30,000 lbs. per sq. in.

The theory that Mr. Pearsons advances in regard to the expansion of ice is instructive, but I believe the failure was due to the expansion of water at the moment of freezing. The question of the shell of ice does not seem of importance, as the expansion of the water, causing the strain, or shock, on the pipe occurred at the moment ice was formed.

Yours very truly, C. H. M. Blake.

Guadalajara, Mex., March 30, 1894.

(In connection with the above, the following letter is especially interesting, as it refers to the first letter from Mr. Blake, published in our issue of March 1.—Ed.)

Sir: The theory advanced by Mr. C. H. M. Blake, and also by Mr. Wm. D. Pence, in your issues of March 1 and 8, respectively, seems to require some further elucidation to fully account for the bursting of stand-pipes from frost, for the ordinary expansion of water when freezing, especially when formed in the usual way in such cases, is easily taken up by the elasticity of the metal; but if there is a pocket of water, as Mr. Pence suggests, or column of confined water which gradually shortens from freezing, then the expansion will eventually produce an enormous pressure on the inclosed water, sufficient to burst the inclosing material. An example of such action is often seen in lead water pipes, which have burst from the same cause, the two ends of a water column being closed, one by the tap, the other by ice, which gradually increases the pressure of the inclosed water as it extends along the pipe, finally bursting the pipe at the weakest point, after expanding it considerably much more so than any direct expansion of the ice would account for.

Yours truly, R. Adams Davy.

Ottawa, March 24, 1894.

WIND BRACING IN THE OLD COLONY BUILDING, CHICAGO.

Sir: In the issue of your paper for Dec. 21 Mr. Purdy in his article on "The Construction of the Old Colony Building," says that the design, referring to portal wind bracing, is entirely new in this building and the Monadnock, being put in both buildings at the same time. As a matter of fact portal wind bracing is in the old portion of the Monadnock Block, designed by Burnham & Root, and built by the Geo. A. Fuller Co. in the spring of 1890. Mr. Purdy was working for Mr. Fuller at that time, and must know that it was so used. It has since been used in the Venetian Building, built by the Geo. A. Fuller Co., and in the Isabella Building. Burnham & Root did not in their design figure the portal as hinged at the center and then built up solid, neither did their portals go down to the floors along the columns, but the system was put in to take care of the wind alone. This scheme for taking care of the wind pressure is not deemed by them of any great importance, and this article is only written to state the true facts in the case.

Yours truly, E. O. Shankland.

Chicago, Ill., Dec. 29, 1893.

(We have referred this letter to Mr. Purdy, who sends us the following reply.—Ed.)

Sir: Your correspondent who questions my state-

ment that the design for the wind bracing in the Old Colony Building is entirely new with that building and the Monadnock Block, practically acknowledges that the wind bracing in the other buildings he refers to, is not of the same design. I send you herewith a drawing (Fig. 1) showing the wind bracing in the old portion of the Monadnock Block, which was designed by Burnham & Root, the architects. If you will refer to the Engineering News of Dec. 26, 1891, you will find drawings of the wind bracing used in the Venetian Building, designed in my office as consulting engineer for Holabird & Roche, architects. I also send you herewith prints of the wind bracing referred to in the Isabella Building (Fig. 2), known at the time the drawings were made as the Van Buren Building, and designed by Jenney & Mundie, architects. An examination of these designs will show to any one that they are all radically different from the design in the Old Colony Building. The bracing in the old portion of the Monadnock was of the same section the entire height of the building, and the lateral strength of the building was secured by its very heavy masonry and cross walls. The design used in the Venetian was more like that used in the Old Colony, but I made no mention of it because in some of its features it seemed hardly worthy to be compared. The work in the Isabella Building is more in the nature of knee braces than portal construction. We may feel assured that it is properly dimensioned and entirely efficient for the purpose intended, but it is unquestionably different. Each of these designs induces column strains that are not involved at all in the construction used in the Old Colony Building.

I did not mean to make a claim that this was the first case where a building was braced without using tension rods. That, of course, would have been absurd. The successful wind bracing in any building must be economical, must be efficient, must be easy of erection, and to that end as largely independent as possible of the rest of the construction, while it is imperative that it shall not injure the building commercially or architecturally. When different systems of bracing are compared it should be with all these points in view, and with the same forces to be overcome.

Yours truly, Corydon T. Purdy.

Chicago, Ill., Jan. 18, 1894.

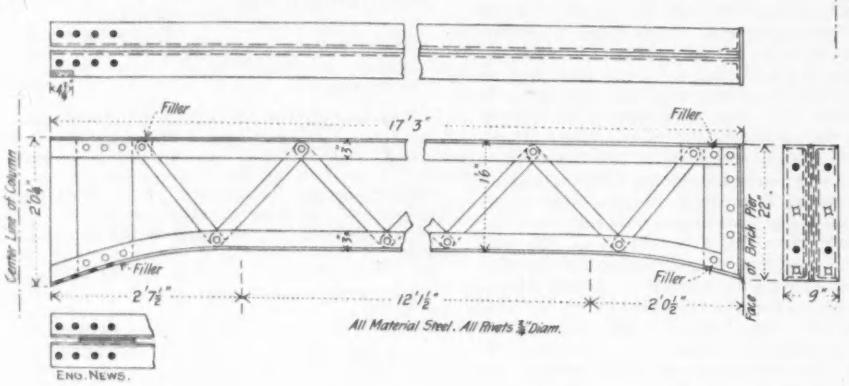


FIG. 1. DETAILS OF WIND BRACING FOR THE OLD PORTION OF THE MONADNOCK, CHICAGO.

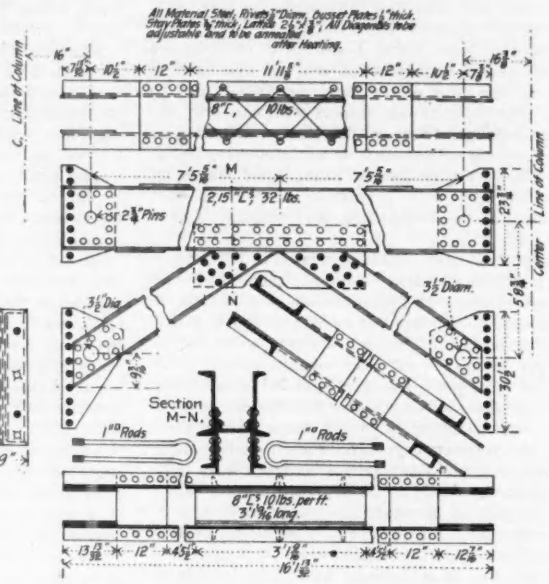

All Material Steel, Rivets ⅞" Diam., Gusset Plates 1" thick, Stay Plates ⅝" thick, Lattice 2½"x⅜", All Diagonals to be adjustable and to be screwed after Heating.
C. Line of Column
8"L, 10 lbs.
7'5⅝" M
2,15 "L" 32 lbs.
2 ST 2¾" Pins
3½" Diam.
N
Section M-N.
1" Rods
1" Rods
8" L's 10 lbs. per ft. 3'1⅝" long.
16'1⅜"

FIG. 2. DETAILS OF WIND BRACING FOR THE ISABELLA BUILDING, CHICAGO.

A PROBLEM IN HYDRAULICS.

Sir: Having had occasion to work out a problem similar to "A Problem in Hydraulics," which appeared in your issue of March 1, I took pleasure in examining the solution there given.

By approaching the problem in a different way a general relation between the total head and the friction, or lost head, may be obtained, which not only greatly simplifies the calculation, but is applicable to all similar cases.

If we let h' = total friction or lost head,
h_1 = useful head,
H = total head,
q = cu. ft. passing in 1 second,
d = diameter of pipe,
l = length of pipe,
f = coefficient of friction = " m,"
n = coefficient of friction at entrance, bends, etc.,

we have $h' = \left[\frac{f\,l}{\frac{1}{4}\,d} + n\right]\frac{v^2}{2\,g}$ But

$$v^2 = \frac{q^2}{\left[\pi\left(\frac{d}{2}\right)^2\right]^2} = \frac{16\,q^2}{\pi^2\,d^4};\ \text{therefore}$$

$h' = \left(\frac{f\,l}{\frac{1}{4}\,d} + n\right)\left(\frac{16}{\pi^2\,d^4}\right)q^2$; or, representing the coefficient of q^2 by c, $h' = C\,q^2$;

$h_1 = H - h' =$ useful head.

Multiplying by q to get the power, we have

$$h_1\,q = H\,q - C\,q^3.$$

Differentiating the power with respect to the quantity of water we get

$$\frac{d\,(h_1\,q)}{d\,q} = H - 3\,C\,q^2.$$

Putting this equal to zero and substituting h' for $C\,q^2$, we have

$$H - 3\,h' = 0 \quad \text{or} \quad h' = \tfrac{1}{3}\,H.$$

This relation is perfectly general and is independent of the coefficient of friction, length of pipe, friction at entrance, etc., since "C" does not enter into the final result.

It denotes that distribution of the total head which gives the maximum power at the end of the cylindrical pipe, and the correction due to varying velocity and diameter in the nozzle would be inappreciable.

Applying this result to Prof. Church's example, we have from the formula:

$$h' = \frac{f\,l}{\frac{1}{4}\,d}\,\frac{v^2}{2\,g},\ v = \sqrt{\frac{2\,g\,h'\,\frac{d}{4}}{f\,l}}.\ \text{Hence}$$

$$v' = \sqrt{\frac{2\,g \times 33.33}{.007 \times 800 \times 16}} = 4.891 \text{ ft. per sec.}$$

The velocity of flow through the nozzle will be, disregarding the slight friction,

$$v = \sqrt{2\,g \times 66.67} = 65.48 \text{ ft. per sec.}$$

$$\text{Now } x^2 = \frac{v'}{v}\,d^2 \therefore x = \sqrt{\frac{4.891}{65.48}} \times \tfrac{1}{4} = .0683 \text{ ft.,}$$

which is the result obtained by the other method.

Troy, N. Y., March 3, 1894. P. L. R.

Sir: Referring to the solution of "A Problem in Hydraulics" by Mr. Church, in your issue of March 1, I give below another solution of this same problem that may be of interest.

1. Let us find what per cent. of the total head must be sacrificed to friction in the pipe, in order to obtain the maximum power. We may practically neglect the entry and velocity heads and resistance of the nozzle, especially as the second tends to offset the third.

Let h = total head, h'' = head lost in friction in the pipe, and h' = that remaining at the nozzle; then $h'' = h - h'$. Also let K = energy, Q = quantity of water discharged, w = weight of unit of volume of water, A = area of bore of pipe, and v = velocity of water in the pipe. Then $K = Q\,w\,h' = A\,v\,w\,h'$, to be a maximum; or, throwing away constants, $v\,h'$ to be a maximum. Now

$$v = \sqrt{\left(\frac{2\,g\,h''\,d}{4\,f\,l}\right)} = \text{constant} \times \sqrt{h''} = \text{const} \times \sqrt{h - h'}$$

Substituting $v\,h' = \text{constant} \times h'\sqrt{h - h'}$, to be a maximum. Again throw away constant. If a quantity is a maximum, its square will be a maximum. Therefore, $h'^2\,(h - h') = h\,h'^2 - h'^3$. Differentiating for a maximum, $2\,h\,h' - 3\,h'^2 = 0$; $2\,h = 3\,h'$; $h' = \frac{2}{3}\,h$, a maximum.

Taking the case in question, l = 800 ft., d = 0.25 ft., h = 100 ft., h' = 66⅔ ft., h'' = 33⅓ ft.; and, by inspection of a table of frictional heads and discharges for clean pipes, we find Q = 15.16 cu. ft. per minute. To obtain v, we have $66\frac{2}{3}$ ft. $= \frac{v^2}{2\,g} = \frac{v^2}{64.4}$, and v = 65.55 ft. per second. Then $\frac{15.16}{60} \div 65.55 =$ .003854 sq. ft. = .554976 sq. in. = area of nozzle. 0.554976 sq. in. $= 3.1416 \times v^2$; v = 0.41 in.; d' = 0.82 in.

In the above, we have made the same assumption as was made by Mr. Church: i. e., that the jet is of same diameter as the nozzle. In practice, correction would have to be made according to kind of nozzle to be used. It can easily be proved experimentally that the assumption made at the start regarding entry and velocity heads and resistance in the nozzle is allowable.

Yours truly, R. G. Gemmell.

Salt Lake City, March 9, 1894.

(We have referred the above communications to Professor Church, the author of the solution first published, and are indebted to him for the following comment:—Ed.)

Sir: Your correspondent, Mr. "P. L. R.," by dividing the treatment into two parts, and using the quantity of water per second as the independent variable, has much simplified the solution of the problem in question. By "q" he evidently means the weight of water per second, and not the volume. The generalization that the lost head should be made one-third of the total head, while strictly confined to cases where that head is proportional to the square of the velocity, is neat and interesting. This relation also applies, it is evident, to the determination of the best speed for Sir William Armstrong's motor described on page 48 of Mr. Bodmer's "Hydraulic Motors," in which the lost head consists principally of two parts, viz.: the friction-head in supply pipe and head due to the velocity of water accompanying and leaving the apparatus; both of which are proportional (one nearly and the other exactly) to the square of the velocity.

Mr. Gemmell, by employing the useful head as the independent variable, before any differentiation is attempted, seems to have effected a further simplification in treatment.

A casual reference to Prof. Cotterill's "Applied Mechanics" (second edition) has just reminded me of a statement in Art. 259 of that work, where transmission of power by hydraulic pressure to water-pressure engines is under consideration. "The power of a motor supplied by a given pipe does not increase indefinitely as its speed increases, but is greatest when one-third of the head is lost in friction." Then follows a footnote, viz.: "This result was pointed out to the writer by Mr. Hearson. It appears to be little known."

Sincerely yours, I. P. Church.

Ithaca, N. Y., March 29, 1894.

NOTES AND QUERIES.

A. C. Braucher, Danville, Ill., propounds the following problem. Answers should be sent direct to him:

Given the distances from a point to the three angles of an equilateral triangle to solve the triangle.

Brunel's famous tunnel under the Thames, in London, completed in 1842, at a cost of $2,350,000, is now used as a railway tunnel, having been bought by the East London Ry. in 1865 for $1,000,000. This tunnel is divided into two single-track lines, with archways through the brick wall between them. The tunnel is 1,200 ft. long under the river, and the two sections are 14 ft. wide and 16 ft. 6 ins. high. The shaft on the north bank is utilized as a means of access from the surface to the Wapping Station in the tunnel.

THE WUENSCH AND MELAN SYSTEMS OF FIREPROOF FLOOR CONSTRUCTION.

Within the last few years Austrian engineers have been adopting various systems of combination iron and concrete arch floor construction in buildings where the floors are subjected to heavy loads, with a considerable reduction in cost and a great gain in the rapidity of construction over the old form of brick arch construction. For some years the Monier system, illustrated and described in Engineering News of May 23, 1891, and Feb. 16, 1893, has been most generally specified for floors, but recently two other systems, the Wuensch and Melan, have been very successfully used in a number of large buildings. The application of these two systems to actual structures is shown in the accompanying illustrations.

In Fig. 1 is shown the construction of the Wuensch system as used in the floors of a large brewery at Budapest, Hungary. In this building the second floor had to be designed for a load of 240 lbs. per sq. ft., and the third floor for a load of 80 lbs. per sq. ft. The space to be covered was $174 \times 52\frac{1}{2}$ ft. Two rows of columns were run lengthwise of the building 18 ft. apart and 16 ft.

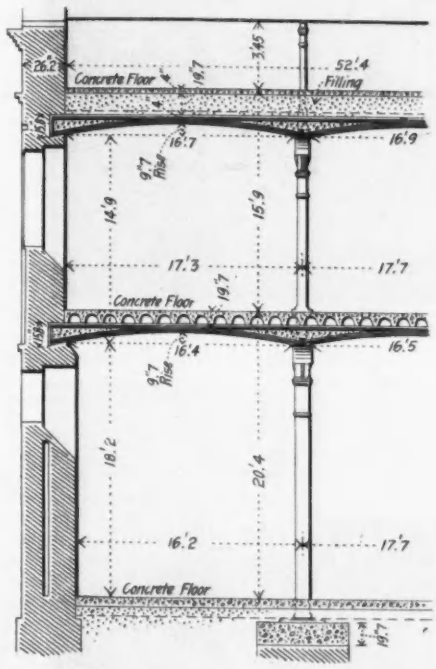


Fig. 1. Transverse Section of Brewery at Budapest, Showing Wuensch System of Iron and Concrete Floor Construction.

from the side walls of the building, and upon these was placed the system of concrete and iron arches shown in the illustration (Fig. 1). As will be seen, this system consists of a series of arches spanning the spaces between columns lengthwise of the building, and these arches carry other arches which span the space transversely. The longitudinal arches act simply as girders which support the arches forming the floor proper and are only $15\frac{1}{4}$ ins. wide, 14 ft. span and 1.4 ft. rise. They are made up of four $2.16 \times 2.16 \times 0.28$-in. angles, two of which are curved to form a bottom chord, so to speak, for tension, and two of which form a horizontal top chord for compression, and are filled in with concrete. It will be seen that the system is simply a modified form of the Monier system, in which the wire nettings are replaced by stiff angle or T-sections.

The transverse arches are constructed in exactly the same manner as the longitudinal arches, except of course that they form continuous vaults the entire length of the building and use T-sections instead of angles for the iron skeleton. Two of these arched vaults have spans of 16 ft. and one a span of 18 ft. and the iron frames are placed 7.9 ins. apart for the second floor and 13 ins. apart for the third floor. The T-sections used are $1 \times 1 \times 0.15$ in. The composition of the concrete was 1 cement, $2\frac{1}{2}$ sand and $3\frac{1}{2}$ broken stone.

The time taken to construct this floor with 8,500 sq. ft. of area was four days; the centers were allowed to stand one week after the concrete had been placed. Mr. Schustler, the designer, works out the cost of the floor, as compared with a floor consisting of twelve 14-ft. span brick arches laid between I-beam girders supported on cast iron columns (a design which was at first proposed for the work) as follows:

	Brick.	Wuensch.	Saving by using Wuensch system.
Weight of floor per sq. ft.	500 lbs.	320 lbs.	180 lbs.
Weight of cast iron columns	82,800 lbs.	65,000 lbs.	17,800 lbs.
Weight of wrought iron used	108,400 lbs.	56,400 lbs.	52,000 lbs.
Volume of brick or concrete	13,603 cu. yds.	798 cu. yds.	562 cu. yds.
Depth of floor	40 ins.	6.7 ins.	33⅓ ins.

Mr. Schustler further states that the saving in cost over brick arches in this floor was 30%. It is to be remembered, however, that this statement applies to the cost of materials and labor in Hungary. The high price of labor in this country would make the saving considerably less.

The second system of floor construction shown is what is known as the Melan system of arch construction. As already described in Engineering News, this system consists in embedding curved I-beams in concrete and has proved very strong under heavy loads. The illustrations, Figs. 2 and 3, show the system as applied to the floor of the spinning-room of a large factory at Tetschen, in Austria. This floor has an area of about 40,000 sq. ft., and is loaded with heavy spinning machinery. As will be seen the concrete is filled in between the beams, coming down below the concave flange of the curved I-beam and being level with the upper flange of the arch. A poorer quality of concrete is generally used for the spandrels and ashes are used for filling. The connection of the curved I-beams at the floor girders is shown in Fig. 3, where it will be seen that simply a couple of wedges are used, there being no riveting of any sort.

The manner of laying the concrete is first to build a centering with tight lagging conforming to the intrados of the arch. The manner of constructing the centering is shown in the accompanying sketch, Fig. 5. The iron frames are then placed and the concrete rammed in place in layers, as is also shown in Fig. 5. In this manner a gang of 14 men have laid from 700 to 800 sq. ft. of floor in a day of ten hours, including the spandrel filling of poorer concrete which, of course, had to be laid separately.

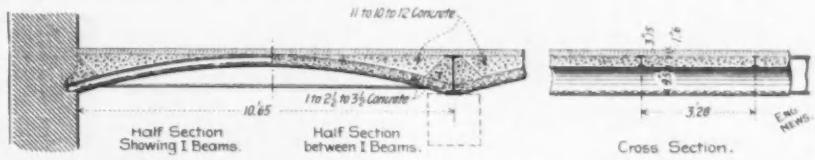


FIG. 2. THE MELAN SYSTEM OF IRON AND CONCRETE FLOOR CONSTRUCTION.

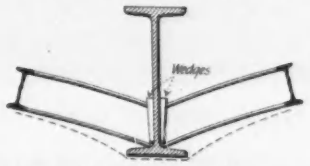


Fig. 3. Connection of Curved I-Beams with Floor Girders, Melan Concrete and Iron Floor Construction.

This gang consisted of four men placing the I-beams, fastening them and placing the centering; one man for sand and one for cement; four men mixing the concrete; two men carrying the concrete and two men ramming it into place. With this gang the amount of concrete laid per hour per man was 2 cu. ft. This record is low, however, and on bridgework the average amount of concrete laid is 5 cu. ft. per man per hour.

In Fig. 2 it will be seen that a tie-rod has been used in the arches abutting against the wall. Usually the stiffness of the I-beams is sufficient to prevent any movement without these. The arrangement of the I-beams and the depths of the concrete for different span arches are shown in the accompanying table:

Space, feet with rise of 1-12 to 1-15.	I-Beams Depth, ins.	Weight.	Dis. apart, ins.	Weight, lbs. per sq. ft. of floor.	Depth of conc. in ins.
10 to 12	3	6	40	1.8	4
12 to 16	4	6	40	1.8	4½
16 to 20	4	7½	40	2.25	4½
20 to 24	5	10	50	2.4	5½

For smaller spans than 10 ft. T-iron instead of I-beams will be used.

In conclusion, it may be of interest to mention some tests recently made by the Austrian Society of Civil Engineers and Architects to determine the comparative strength of different systems of concrete arch floor construction. The Wuensch system was not included in these tests, but other tests made by the Hungarian Government show it to be far superior to the Monier system. These tests may be tabulated as follows:

	Brick.	Concrete.	Monier.	Melan.
Span	13½	13½	13½	13½
Rise	1.5¾	1.5¾	1.5¾	11
Thickness at crown.	6	4	2⅜	3⅜
Lbs. iron used per sq. ft.	..	..	8	7.4
Breaking load, lbs., per sq. ft.	321½	737	839	3,360

We are informed that in practice the relative strengths of the several arches when all are made

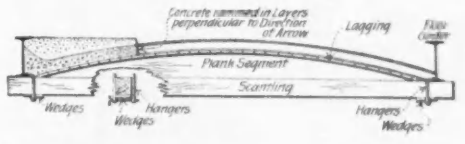


Fig. 4. Sketch Showing Method of Constructing Melan Concrete and Iron Floors.

of equal thickness are as follows: Brick arch, 1; concrete arch, 5; Monier arch, 16; Melan arch, 3½. On the other hand, the relative thickness of different arches of the same strength would be: Brick arch, 12 ins.; concrete arch, 5 ins.; Monier arch, 3 ins.; Melan arch, 2 ins.

INTERNATIONAL STANDARDS FOR THE ANALYSIS OF IRON AND STEEL.

The sub-committee on international standards for the analysis of iron and steel appointed at the World's Congress of Chemists last summer has issued a second bulletin requesting all chemists interested in iron and steel analysis to send to the sub-committee an outline of the processes or methods which they use and prefer for the determination of the different elements in iron and steel, and for any information and suggestions in connection with this subject. The following list of questions is propounded:

1. What general method do you use for the determination of phosphorus in iron and steel?
2. What special precautions do you consider necessary to make this method reliable?
3. What precautions do you take to prevent the interference of arsenic?
4. What factors do you use in your calculations?
5. What variations do you introduce in the case of iron ores or slags?
6. Do you use the same method in pig iron and steel, and do you consider the results equally reliable?
7. Do you ever examine the residues insoluble in acid, in pig irons, or iron ores, and do you ever find phosphorus in them?
8. Are all your determinations made by the same method, or do you check your work by reference to another method, and if so, what method do you use for this purpose?
9. How many determinations do you make a day in your laboratory under ordinary circumstances?
10. What do you consider the greatest length of time necessary to obtain a result, permissible in your work?

Correspondence should be addressed to the chairman of the committee, Dr. Chas. B. Dudley, Altoona, Pa.

THE PEORIA STAND-PIPE FAILURE.

The failure of the 25×120-ft. steel and wrought iron stand pipe at Peoria, Ill., on March 30, was described in detail in our last issue. The material for the accompanying illustrations, Figs. 1 to 4, was received too late for insertion last week, and since then the additional information given below has been sent to us. The photographs from which Figs. 2, 3 and 4 were made were sent through the kindness of Mr. Chester B. Davis, M. Am. Soc. C. E., of Chicago, and Mr. Dabney H. Maury, Jr., Superintendent of the Peoria Water Co. The sketch plan, Fig. 1, was sent by Mr. Maury, as were certain notes credited to him below.

The location of the stand-pipe is shown in Fig. 1, in which is also indicated the position of the various portions of the wrecked pipe and the original and present location of the damaged buildings, the fragments of pipe being indicated by numerals and the buildings by letters.

The view, Fig. 2, looking northeast shows the base and foundation of the stand-pipe and the location of the inlet. The child in the foreground was rescued uninjured from one of the wrecked cottages. The portion of the pipe shown partially straightened out at the left of the view is the seventh course. The fracture of this course was at a point a little east of the south side of the pipe.

Fragment No. 11, driven partly under Building F, Fig. 1, was a part of the bottom course. It measures about 15×40 ft. The north edge of this

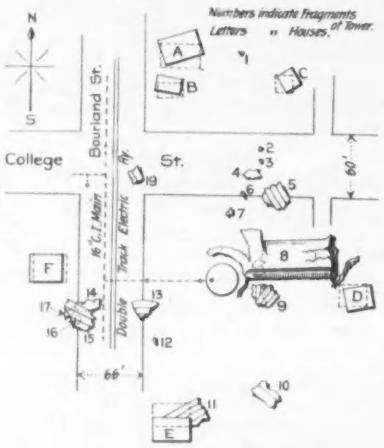


Fig. 1. Sketch Plan Showing Position of Fragments of Wrecked Stand-Pipe and Buildings, Peoria, Ill.

fragment is said to have been practically the exact east side or element of the pipe. At least two of the holding-down bolts were attached to this piece of the pipe.

Fig. 3, looking southeast, shows the upper part of the pipe, the metal in the foreground being a part of the ninth course. The blocking under the pipe, shown in both Figs. 3 and 4, was placed there by the company to raise the wreck in the search for bodies. Fig. 4 shows the upper portion of the pipe from the upper end, the view having been taken from a point a little south of east.

The following notes relating to the failure were furnished to us by Mr. Dabney Maury, Jr., Superintendent of the Peoria Water Co., and are of especial interest as having, in the opinion of Mr. Maury, a bearing upon the question of electrolysis:

A study of the fractures shows that in nearly every instance ruptures in a vertical direction have been through the sheets rather than along the triple or double riveted vertical joints, and that in most instances transverse ruptures were through the rivet holes of the single riveted horizontal joints. A careful and thorough study of the wreck, with a hope of determining its cause, is being made by the superintendent and by the company's consulting engineer. Those injured in the accident are doing so well it is thought that no serious or permanent injuries will result to any of them.

The foundation of the tower was left entirely uninjured, save that portions of the coping or water table stone, which was put in in twelve pieces, were moved or broken. Three pieces, each weighing about 100 lbs., were carried about 150 ft. south and east. The earth around the foundation was washed away for a depth of from 3 to 5 ft. for a distance of 20 to 30 ft. from the tower.

It may be interesting to note that the inner surface of the sheets shows a peculiar corrosion similar to that which has often been observed here in the cast iron and wrought iron water pipes, which it has been necessary to remove or repair on account of electrolysis. This corrosion takes the form of blisters or excrescences, generally elongated and globular in shape, with the longer axis vertical. These blisters are composed of a skin of brown oxide overlying what appears to be a thin coating of black oxide. Under this second coating the surface is pitted, often to a depth of ⅛-in. The surface at the pits, when the oxide is removed, shows a clean metallic appearance. The inside of the 16-in. cast iron inlet pipe, which was not painted, or coated, shows similar but larger blisters and pits. The blisters and pits appear to increase in number and size from the top towards the bottom of the stand-pipe, the small pits near the top, however, being almost as deep as the larger ones lower down.

The inner surface of the upper course of sheets, which is seldom wet, shows very little oxidation, and none of this character. The two next courses, which are alternately wet and dry, show this corrosion to a limited extent. The 16-in. branch feeding the tower is crossed by a double track electric railway (see Fig. 1), which runs along the main for nearly a mile from the tower. All the principal mains of the system are paralleled or crossed by double track electric railways. The same corrosion is observed in the tower on the east bluff.

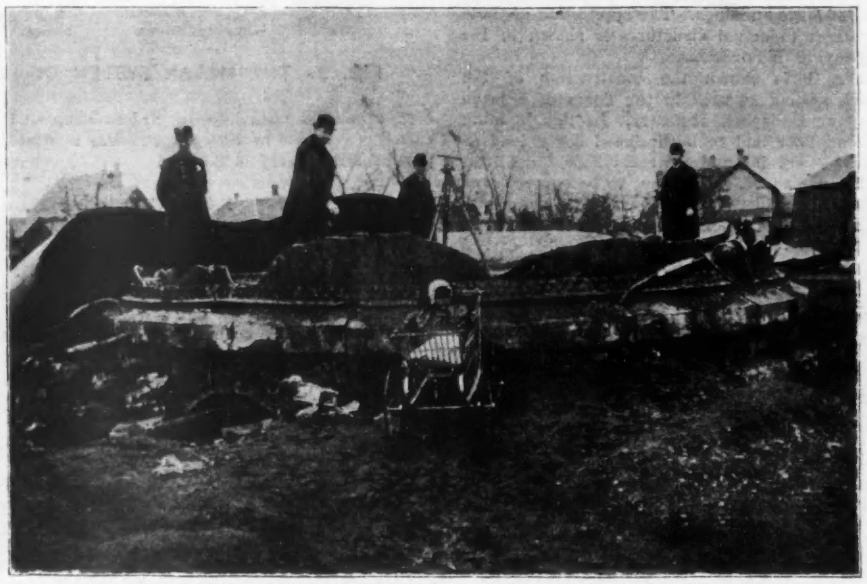


FIG. 2. VIEW OF BASE AND FOUNDATION OF STAND-PIPE, LOOKING NORTHEAST

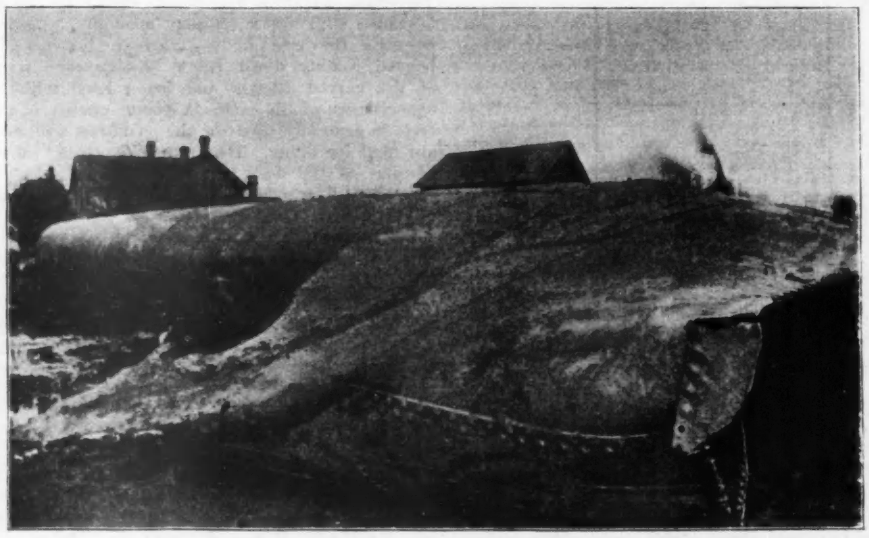


FIG. 3. VIEW OF UPPER PART OF STAND-PIPE, LOOKING SOUTHEAST.

We have received from Prof. Wm. D. Pence, under date of April 7, a letter supplementing, and in some respects correcting, his report in our last issue, which report of necessity was prepared in great haste. Professor Pence's letter is given here in order to keep the discussion together as much as possible, and is as follows:

I beg to call attention to a typographical error in my report of the Peoria stand-pipe failure published in your issue of April 5, which reverses the meaning intended for a very important statement. In describing the characteristic behavior of stand-pipes which have heretofore failed under simple hydrostatic pressure, a statement is made concerning the directions in which the fragments of plates are usually projected, and at the conclusion of the third observation, in which it was intended to say that, as a rule, none of the plates are thrown in the direction of the point of first failure, it reads, "more are thrown in that direction." Since this error leads to a contradiction in a very important premise in my theory of the failure, I feel free in requesting space for the correction.

Also, in another place, I said westward where eastward was intended in referring to the direction toward which the upper portion fell, although this error is made apparent by the accompanying and preceding statements.

A word in regard to the velocity of the wind at the time of the failure seems proper in view of the striking contrast between the figures given in my own report ("about 30 miles per hour") and those stated in the detached report which preceded it ("probably not over 6 or 8 miles per hour"). My informant states that upon hearing of the failure, which was almost immediately after its occurrence, he was impressed with

the severity of the wind, and made a mental estimate of its velocity at 30 miles per hour. Upon being closely questioned, he seemed to have a full appreciation of the difficulties and uncertainties which surround the estimation of wind velocities. Moreover, the difficulties experienced in keeping the ladders in place for the use of the men who were repairing the stand-pipe at the moment of failure, suggests that the wind must have far exceeded in force a "fresh breeze" which, according to the well-known Smeaton rules, would correspond to 12½ miles per hour. Those rules give 25 miles per hour as a "brisk wind," and 30 miles per hour as a "strong wind."

FIG. 4. VIEW OF UPPER PART OF STAND-PIPE FROM A POINT A LITTLE SOUTH OF EAST

Further communications regarding this failure, received too late for this issue, will be presented in a subsequent number.

TRIAL OF THE WESTINGHOUSE HIGH-SPEED BRAKE.

In view of the general increase in passenger train speeds and the introduction of express trains running at exceptionally high speeds, Mr. Geo. H. Westinghouse has devoted considerable time to improvements in the Westinghouse brake to fit it especially for this class of service, and a trial of the improved brake was made April 10 on the Pennsylvania R. R. between Ship Road and Downington, Pa., on the Philadelphia Division. Two trains were used, each consisting of an eight-wheel engine (Class 0) weighing 161,650 lbs., and six day cars weighing approximately 64,000 lbs. each, the actual weight of cars being 393,310 lbs. for the train with the new brake and 389,500 lbs. for the other. In the former train the cars had a brake force approximately as great as the present construction of trucks is calculated to stand, the maximum being about double that used in regular service. The locomotive had brakes on all wheels, including the truck, the maximum braking force being increased substantially the same as on the cars. The high-speed brake is the regular quick-action brake used with about 80 lbs. pressure per sq. in. in the trainpipe and supplemented by a pressure relief valve which automatically reduces the increased pressure in the brake cylinder at a rate practically in proportion to the reduction in the speed of the train and to a pressure that will not slide the wheels at low pressures. The extra pressure is obtained by the use of larger cylinders and consequent larger piston area, but on the trial train the cylinders were somewhat too large for the light and practically empty day cars (being just about right for heavy Pullman cars), and the result was that the wheels were skidded. New brakeshoes had been recently applied and had not been worn to a full bearing, which also diminished the comparative value of the trial. The other train was fitted with the standard quick-action brake equipment, but the brake pressures were considerably in excess of those used in regular service. The result of having cylinders too large on the one train and unusually high pressures on the other was to show an apparent greater efficiency of the ordinary brake, which stopped its train in less time and shorter distance than the high-speed brake, this greater efficiency, however, being apparent and not real when all conditions are considered. The results are being worked up and will be made public later.

The runs were made on straight track with a down grade of 20 to 27 ft. per mile, and a wet snowstorm put the rails in rather bad condition for tests. The engine of the high-speed train was fitted with a Boyer speed indicator, and in the front car was fitted a Kapteyn speed indicator and recorder, driven by a belt from one of the axles. In the first three trials the trains were run side by side, the engineman of the train with the ordinary brake keeping steadily abreast of the other, and the brakes were set automatically by trips placed at the side of the track. The regular brakes were then fitted with the pressure-releasing valves used in connection with the high-speed brake and this train was then run twice by the engine fitted with this brake, the air pressure being increased in these tests to an extent that can safely be used in regular practice with the existing standard brake gear of the Pennsylvania R. R. These two tests were made for the purpose of showing the results that can be obtained without any other modifications or changes in brake equipment than the application of brakes to the front trucks of locomotives (a practice which is certainly coming rapidly into favor for express engines), and the use of the special high-speed brake-releasing valve in connection with the existing quick-action triple valves on the cars, and showed conclusively the advantages thus gained over ordinary practice. All of the stops were made as emergency stops, sand being used in each case, but through some defect in the sand cocks, the "high-speed" engine did not get much sand on the rail. The experiments were in charge of Mr. H. H. Westinghouse, Mr. R. A. Parke and Mr. Geo. C. Evans, of the Westinghouse Brake Co., and Mr. T. N. Ely, Superintendent of Motive Power of the Pennsylvania R. R. A large number of railway men were also present.

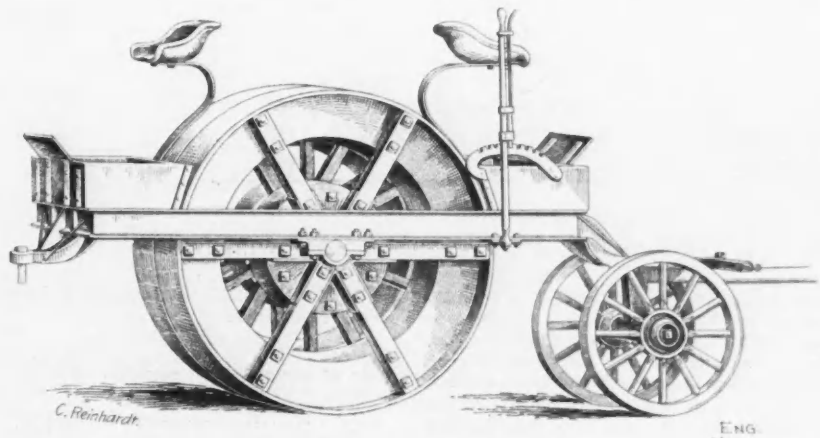
The following table shows the general results of the trials, and though these results were not quite what had been expected, owing to the causes stated above, they showed the advantages of the high-speed attachments, especially in the last two runs, the "quick-action" train being then converted into the "high-speed" train with marked improvement in the stops even above those previously obtained under exceptionally favorable circumstances with the ordinay "quick-action" brake. Further trials are to be made shortly and we shall publish later a more complete account:

	Distance run after applic.		Time of stop.		Reservoir press.		Brake cylinder pressure at applic. and stop.	
Speed, miles per hour.	High sp., feet.	Q. act., feet.	Hi. sp., sec.	Q. act., sec.	Hi. sp., lbs.	Q. act., lbs.	Hi. sp., lbs.	Q. act., lbs.
44	800	712	25	27	80	80	55 to 32	66 to 55
57½	1,636	1,593	34	27	83	78	42 " 29	64 " 61
59	1,454	1,325	30	26	90	81	48 " 30	69 " 65
61	1,155	..	22	..	..	..	80 " 61	..
64	1,325	..	24	..	..	..	80½ " 61	..

THE CHAMPION STEEL ROAD ROLLER.

We illustrate herewith a new pattern of road roller recently placed on the market by the American Road Machine Co., of Kennett Square, Pa. The frame is built of steel channels and is fitted with a steel box at each end which may be loaded with pig iron or stone to increase the weight of the machine. Each box will hold about a ton of pig iron. The roller consists of two steel castings, each 5 ft. in diameter and 2 ft. 6 ins. face, giving a rolling width of 5 ft. The use of steel for the roller in place of cast iron is a notable innovation on ordinary practice.

As seen by the drawing, the front end of the roller frame is carried by a two-wheeled truck; and while the roller may be easily turned by reason of its being made in two parts which revolve independently, the turn may also be made by simply removing the king-bolt and attaching the truck to the opposite end. The use of the truck has the further advantage of relieving the strain on the horses' necks, which only have the weight of the pole to carry. The roller is fitted with a powerful brake, which is a great relief to the horses when working on hilly roads. It is made in weights of 2½, 3½, 4½ and 5½ tons, and the ballast boxes enable the working weight to be regulated according to the character of the road to be rolled.



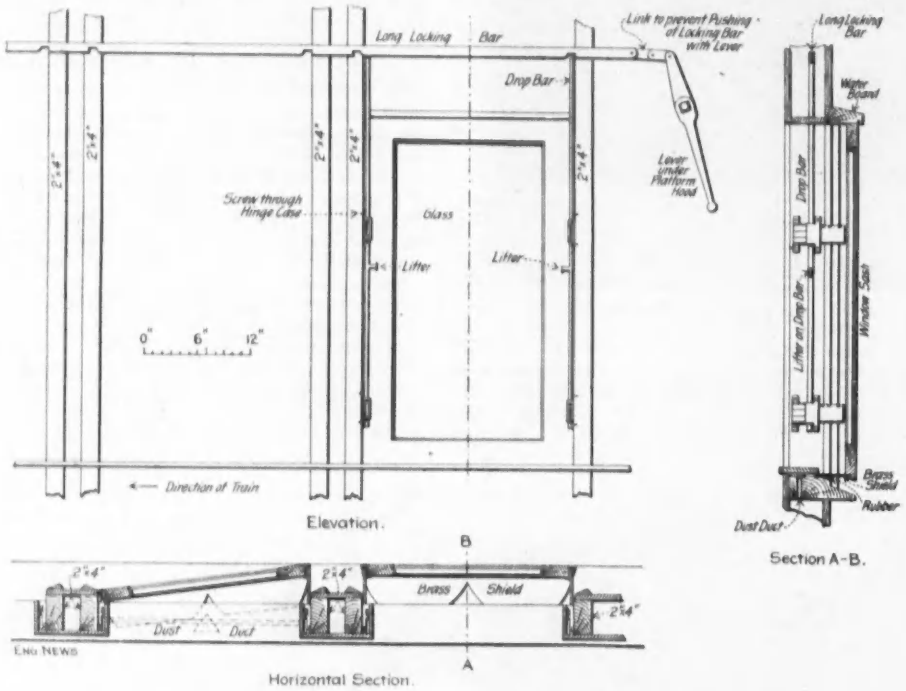
THE "CHAMPION" STEEL ROAD ROLLER.

A new form of railway ticket, obviating all waiting at the ticket office, is being introduced on the Hungarian railways by the Hungarian Minister of Railways, Lukais. Blank cards and "stamps" will be on sale at all the tobacco shops and on this card the traveler writes the names of the stations of departure and intended destination; he then sticks on this card as many government railway stamps as the journey will cost.

THE DE KALB VENTILATING WINDOW FOR RAILWAY CARS.

One of the great defects in modern passenger cars of all classes is the inadequacy of ventilation, as we have frequently pointed out, and it is to be hoped that the M. C. B. committee on car ventilation will make a good and thorough report at the convention next June. We illustrate this week the De Kalb ventilating window, which is in use on a day car of the Delaware, Lackawanna & Western R. R., running regularly between Binghamton and Oswego, N. Y. The car, as fitted with these windows, has been in regular service since June 20, 1893, and has also made a trip from Syracuse to Chicago and back and from Syracuse to New York and back. In both cases the windows were purposely opened in the tunnels, and it is stated that the small quantity of smoke that leaked in around the drop window in the door and at the forward deck lights were exhausted from the windows, so that scarcely a trace of smoke was found at the rear end of the car.

The window has a single sash, hinged at both sides by slip hinges, so that either side can be opened, or the sash can be pushed outward, parallel with the side of the car. Under ordinary conditions, however, the window is swung open from the front hinges, so that the opening is protected by the sash. The rush of air past the window creates an exhaust, drawing out the air from the car, fresh air being supplied through the deck windows, in summer, while in winter the leakage of air around the deck windows and front door supplies sufficient fresh air, so that there is a continuous exhaust through the windows, even when the deck windows are closed. The maximum width of openings is about 2 ins., but may be as much as desired, each window being operated independently of the others. To prevent the sashes from being opened the wrong way, however, a locking rod extends the length of the car, being hidden in the casing over the window, and is fitted with a handle over each platform. This rod is fitted with a lifting bar to each side of each sash, and the brakeman operates the locking rod to lock the hinges of the leading side of the window, in the same way that on many suburban cars the brakeman opens and closes alternate deck lights simultaneously according to the direction in which the car is running. The hinges on one or both sides can be locked, or unlocked, the latter only being done when the train is standing still, so as to give ample opening. A water table over the windows prevents the entrance of rain or dust from the top, and a brass shield on the bottom of the sash prevents the dust from entering at the bottom opening. This shield slides in a groove under the sill. The sash closes against rubber strips, making a watertight fit when closed. In the elevation it will be seen that the lifter bar at the left of the window cannot be raised to free the hinge, so that the sash can only be opened at the right hand side, as shown on the left of the plan. The fittings are simple and inexpensive and the window and attachments can be fitted to old cars with little trouble. The inventor is Mr. Enoch E. De Kalb, of Syracuse, N. Y.



THE DE KALB VENTILATING CAR WINDOW.

ESTIMATING THE VALUE OF A RAILWAY.

The value of the railways in the state of Texas, estimated on the basis of the cost at which they could be replaced, is being ascertained by the Texas State Railroad Commission. The estimate has been completed for the Texas & Pacific Ry., one of the highest capitalized railways in the state. The following table showing the value of the various items has been compiled from figures furnished us by Mr. Frank E. Snyder, one of the engineers of the commission:

	Value.	P. c. of total value.
Right of way and depot grounds..	$451,136	2.54
Clearing and grubbing	160,967	0.9
Excavation:		
Earth	1,827,064	10.3
Loose rock	194,390	1.0
Solid rock	578,716	3.2
Wet	1,352	0.007
Bridge masonry	69,367	0.38
Culvert "	60,033	0.33
Earthenware and box drains	3,216	0.018
Iron bridges	124,441	0.75
Combination bridges	137,500	0.77
Wooden trusses	48,330	0.27
Trestle bridges	911,922	5.1
Cross ties	1,799,205	10.1
Rails, spikes, joints and switches..	4,362,300	24.6
Tracklaying	600,294	3.3
Ballast	526,689	2.9
Depots, platforms, stock pens, coal chutes	317,337	1.7
Section houses	104,155	0.5
Water stations	128,072	0.6
Road crossings and cattle guards..	41,331	0.2
Turntables and track scales	23,350	0.1
Fencing	112,864	0.51
Signs	3,094	0.01
Machine shops, round houses, offices	1,500,779	8.4
Tools, supplies, etc.	87,600	0.4
Rolling stock	1,844,010	10.4
Engineering, superintendence, legal expenses	961,013	5.4
Interest during construction	752,793	4.2
	$17,730,689	

The value of the railway per mile of line is $17,060 according to these figures, there being 1,039 miles of the system in Texas. To gather the necessary data upon which to base these estimates of values, the engineers of the commission have examined personally each mile of the road, measuring and recording all cuts, fills, bridges, tunnels, buildings and other physical features in detail. The work has been done in accordance with an act passed by the State Legislature in 1893 entitled "an act to define franchises, to make public the value of railways, to limit the amount of stocks, bonds and other indebtedness that may be issued by them and to prescribe the duties of the Railroad Commission and Attorney-General in relation thereto." The examination of the Texas & Pacific Ry. will be followed by a similar examination of all the railways in the state.

By the new Naval Appropriation bill, as reported by the House Committee, the Secretary of the Navy is authorized to use $450,000 previously appropriated for the building of an additional vessel of the "Vesuvius" type for the construction, armament and equipment of three torpedo boats, and to utilize $200,000 appropriated in 1893 for building a submarine boat for the construction of a torpedo boat. He is also authorized to convert the "Vesuvius" into a torpedo cruiser if he thinks such transformation advisable for naval purposes.

The new Austrian Salvator quick-firing machine gun is said to weigh only half as much as the Maxim gun, while it has the same average rapidity of fire, or 300 rounds per minute, with a maximum of 320 rounds. It is not a field gun, however, but is intended for use on outworks. The caliber is the same as for the Mannlicher repeating rifle used by the Austrians; and though it has no water jacket, 1,200 continuous rounds can be fired before it shows the effect of excessive heat. The cartridges are supplied from a hopper fixed above the firing chamber, and they are fired by an ordinary trigger, with trigger-grip and a recoil spring for automatic action. The most important innovation is a pendulum attachment by which the rapidity of fire can be nicely regulated to 30, 50 or 100 rounds per minute. In this respect it surpasses the Maxim, which has only "single fire" and "continuous fire" at the maximum rate. The Salvator method results in an enormous saving in ammunition.

A rack railway up Ben Nevis, in Scotland, is projected. It will be four miles long, with a maximum grade of 1 in 2.62 (39%) for a length of 1,800 ft., and the sharpest curve will be 396 ft. radius, or 14°. The rack and the rails will be bolted to crossties connected by longitudinals, forming a frame which will be anchored to masonry foundations at intervals. The cost is estimated at $150,000. The Mount Pilatus rack railway has a maximum grade of 1 in 2.2 (45.5%) and the Rigi Railway has a maximum grade of 1 in 4 (25%).

The survey for a drainage system for New Orleans, now being conducted under the direction of Mr. L. W. Brown, City Engineer, is about completed and investigations as to run-off are being made. Mr. Brown states that the plans for the system are being worked up, but that it will be some months before they can be completed. Messrs. Rudolph Hering, B. M. Harrod and H. B. Richardson, as engineers, and R. M. Walmsley, J. C. Denis and E. C. Fenner constitute an advisory drainage board, all of the board except Mr. Hering, of New York, being New Orleans men, and Mr. Walmsley being chairman. Mr. A. R. Littlejohn is first assistant engineer of the work.

The height of the bridges across the Manchester Ship Canal has not been fully understood by ship owners, and the company has therefore explained matters in full. All the fixed bridges have a clear headway from under girder of bridge to the normal water level of 75 ft., but when altering masts or building new steamers, owners are recommended not to have their masts higher than 70 ft. above "light water line," as in case of flood or high tide the 75-ft. headway might be reduced a few feet, which might necessitate the detention of the vessel for an hour or so, until the tide or flood had subsided. As to the depth of water there is now a minimum depth of 23 ft. from Eastham to Manchester, and this depth will be increased during the next three months to 26 ft. It is stated that the bark "Sophie Wilhelmine" left Manchester in ballast and passed safely down the canal, the height of her masts from water line, as stated by the master, being 74 ft. 3 ins. The heights of the fixed bridges are as follows:

Bridge.	Height above water level. ft.	ins.
Irlam Railway Viaduct	75	3
Partington Railway Viaduct	75	4
Warburton High-level Bridge	75	3
Latchford Railway Viaduct	77	1½
Latchford High-level Bridge	76	9½
Acton Grange Railway Viaduct	77	2½

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

RAILWAYS.

East of Chicago—Existing Roads.

ATLANTIC & NORTHWEST.—It is stated that the proposed extension of this railway from Egansville, Ont., toward Parry Sound is to be commenced this summer. The line is leased to the Canadian Pacific.

BANGOR & AROOSTOOK.—The town of Patten, Me., has voted $15,000 to secure an extension of this railway to that town, a distance of about four miles.

OTTAWA, ARNPRIOR & PARRY SOUND.—The contract for constructing the 30-mile extension from Barry's Bay to Long Lake, Ont., has been awarded to E. F. Farquhar, according to reports.

PENNSYLVANIA.—The Baltimore "Sun" states as follows: A corps of Pennsylvania R. R. Co.'s engineers arrived at Elkton April 7 under William H. Brown, Ch. Engr., and in charge of W. D. Pritchard, of New Jersey, for the purpose of beginning a survey of the proposed route for the new Elkton, Middletown & Massey R. R. The route will be from Elkton through Chesapeake City to St. Augustine, at which point the road will divide, one branch going to Middletown, Del., the other through Cecilton to Massey, on the Queen Anne & Kent R. R. The construction of this road will open up a rich and prosperous section of the country heretofore without railway facilities. According to the terms of the bill passed by the last legislature of Maryland, which transferred to this new company the $58,000 appropriated several years ago by the state of Maryland to the Elkton & Middletown Ry., provisions are made that the work shall be commenced within 90 days from the passage of the act, and that the road shall be completed as far as Cecilton, in the first district of this county, within one year and completed to Massey in two years.——A Pittsburg paper states that surveys are being made for an extension of this railway to Morgantown, W. Va., from Brownsville or Fairchance, and that the grading is likely to be commenced this summer.

TOLEDO, ANN ARBOR & NORTH MICHIGAN.—H. E. Riggs, Ch. Engr., Toledo, informs us that considerable work is projected in improving the track and reducing grades on the Southern Division of this road. There is also talk of building a slip and terminal yard at Menominee, Mich., somewhat similar to the one illustrated and described in Engineering News of June 15, 1893.

WEST VIRGINIA, CENTRAL & PITTSBURG.—Nearly 100 bids were received for constructing the Baltimore & Cumberland Ry., and it is not expected that the names of the successful bidders will be known before April 15.

Projects and Surveys.

BELT LINE.—Incorporated at Salisbury, Md., to build a railway to connect several factories with the New York, Philadelphia & Norfolk; capital stock, $25,000; A. A. Gillis, Randolph Humphreys.

CHITTENDEN, COUNTY.—The town of Hinesburg, Vt., has voted $25,000 to aid in the construction of this proposed railway from that village to Burlington, a distance of about 12 miles. Engr., Frank O. Sinclair, Burlington, Vt.

ONTARIO & RAINY RIVER.—A press report from Toronto, Ont., states that a deputation, which included Mayor McKellar, Fort William, and S. J. Dawson, ex-M. P., Port Arthur; Z. Mailhat, Ch. Engr., Rainy River Ry.; D. F. Burk, Port Arthur; George Thompson, Winnepeg; Hugh Blair, Pres. board of trade, Toronto; and others accompanied by Messrs. Charlton, Sharpe and Carpenter, M. P.'s, have asked the government to give a land grant to this company or else to guarantee the bonds for a period of 20 years. After listening to the representations of the different members of the deputation, Sir Oliver Mowat promised that the proposal would be considered. It is understood the intention of the promoters is to connect with the Manitoba Southeastern Ry., now being pushed by Winnipeg people.

PENNSYLVANIA & WEST VIRGINIA.—A press report states that the construction of this projected railway may soon be resumed. About 50 miles of grading was done on the line from Mann's Choice to Bedford, Pa., several years ago, and it is now stated that $200,000 has been pledged to secure its construction from Harrisburg to Cessna, Pa. Ch. Engr., John Dadley, Bedford, Pa.

Southern—Existing Roads.

FARMVILLE & POWHATAN.—This company, through W. B. McIlwain, counsel, offers to complete the proposed Richmond, Petersburg & Carolina road from Petersburg to the North Carolina line and buy the property and franchise of the road now held by the city of Petersburg, Va. The question is being considered by the city council of Petersburg. The city has interests amounting to $150,000 in this road. This would be one of the portions of the proposed system giving the Richmond & Manassas a connection with the Seaboard Air Line.

YAZOO & MISSISSIPPI VALLEY.—This company is reported as considering the question of widening the gauge of the Natchez, Jackson & Columbus, 115 miles in length.

Projects and Surveys.

ALABAMA.—H. S. Freeman, Decatur, Ala., is reported as interested in a proposed steam dummy line from that city to Moulton.

FAIRMOUNT VALLEY.—It is reported that the construction of this railway will soon be commenced. Campbell county, Tennessee, has voted to take $50,000 of the stock.

NORTH CAROLINA.—A press report states that a survey has just been completed for a new railway from Bessemer City, N. C., on the Richmond & Danville, to Crouse's station, near Shelby, on the Carolina Central. This new road will be about 12 miles long and will be built by a company organized by Bessemer City capitalists.

TAMPA, CLEARWATER & GULF BEACH.—It is reported that the construction of this proposed railway from Tampa to Clearwater Harbor, Fla., 25 miles, will soon be commenced. Pres., S. A. Jones, Tampa, Fla.

Northwest—Existing Roads.

CHICAGO & NORTHWESTERN.—It is stated that this company proposes to build a branch five miles long, from Havelock south to Pocahontas Center, Ia.

ILLINOIS CENTRAL.—Efforts are being made to secure an extension of this railway from Onawa, Ia., to Omaha, according to press reports.

Projects and Surveys.

CHICAGO, YANKTON & SOUTHWESTERN.—Incorporated to build a railway from LeMars, Ia., to Yankton, S. Dak.; capital stock, $600,000; incorporators, J. R. Hanson, S. B. Coulson, Yankton, S. Dak.; A. M. Holton, R. A. W. James, Chicago; Chas. Whitlock, Sr., Park Ridge, Ill.

CHICAGO, SUPERIOR & PACIFIC.—The incorporation of the company was noted March 29. A press dispatch reports Wm. R. Chadsey as stating regarding the extension of the Canadian Pacific Ry. over the Air-line roadbed through Wisconsin, that it is intended to have the old engineers out on the line the early part of April, taking the old route followed by Capt. Edward Ruger in 1872 and 1873, starting from Wabash Ry. Junction, near the city limits of Chicago, in the town of Lyons, making a junction with the Atchison, Topeka & Santa Fe R. R. at Canal crossing for entrance to Dearborn Street station, then to state line.

ST. CLAIR COUNTY COAL.—A certificate has been filed with the secretary of state in Illinois, setting forth that this company has changed its name to the St. Clair County Belt R. R. Co., has increased its capital stock from $100,000 to $500,000, and will issue bonds to the amount of $500,000 on its property, franchises and rights. The company was incorporated in December, 1892, to build a railway from Madison to East St. Louis.

Southwest—Existing Roads.

PECOS VALLEY.—J. J. Hagerman, Pres., Colorado Springs, Colo., is reported as stating that the company has let the contract to extend its road from Eddy to Roswell, N. Mex., a distance of 75 miles, to J. H. Hampson, Kansas City, the work to be completed in September next. The extension will open for settlement one of the finest bodies of irrigated lands in the West, and will bring the Pecos Valley into direct communication with Denver. Press reports state that it is the intention of this road to connect itself with the Santa Fe at Albuquerque or other convenient point, and the building of it to Roswell is the first step in that direction. It is believed that it will be completed to the Santa Fe in the near future, and thus give Western Texas a near connection with Colorado.

PINE BLUFF & EASTERN.—It is reported that this road is to be extended to Gillett, Ark., 15 miles, to connect with the Stuttgart & Arkansas River.

TEXAS & PACIFIC.—Efforts are being made at Breaux Bridge, La., to urge upon this company the importance of building a proposed line from Palmetto, a station on the Texas & Pacific, by way of Port Barre, Leonville, Arnaudville, Breaux Bridge, Lafayette, to Abbeville, in Vermillion parish, and from there to deep water in Vermillion Bay.

TEXAS MIDLAND.—E. H. R. Green, Pres., Terrell, Tex., is reported as stating that this road will be extended from Roberts to Paris, Tex., and that the construction will be commenced on the extension in about ten days. The work will be pushed and the road will be completed before the end of the year. The distance of the proposed extension is about 65 miles through some of the best country in North Texas. It is a fine cotton country and the prospects now are very flattering for a big crop this year.

Projects and Surveys.

CENTER & TENEHA.—Organized at Center, Tex., to build a railway from Center to Teneha, about 11 miles, to connect with the Houston, East & West Texas road. It is proposed to secure local subscriptions amounting to $18,000 to grade the line. The balance of the work will be done by E. S. Hicks, a lumberman of Teneha, and the Houston, East & West Texas Railroad. Address R. L. Parker, Center, Tex.

CORPUS CHRISTI & BROWNSVILLE.—Sidney Miller, New York, who has agreed to build a railway between Corpus Christi and Brownsville, Tex., is reported as purchasing the rails, etc., and about to commence the construction of the road. Col U. Gussett, Corpus Christi, is said to be interested.

KANSAS CITY & WALDO.—Incorporated at Kansas City, Mo., to build a railway to Waldo Junction, five miles; capital stock, $150,000; W. E. Winner, Geo. Law, E. S. Young and others.

LAKE SUPERIOR, SOUTHWESTERN & GULF.—The Interstate Construction Co., New York, has been awarded the contract for the construction of that part of this railway from Springfield, Mo., to Little Rock, Ark., with branches, a total distance of 285 miles. The work is to be completed in two years.

PALESTINE & DALLAS.—Incorporated in Texas to build the proposed railway between Palestine and Dallas; capital stock, $1,000,000; Pres., Geo. W. Burkett; Treas., Hugh Burns; Secy., H. L. Wright.

SAN ANTONIO & GULF SHORE.—A press report from San Antonio, Tex., states as follows: The contract for the construction of the San Antonio & Gulf Shore R. R. was let April 9 to Massey & Co., of Kansas City. The line is to be extended from this city to Velasco, a distance of 170 miles. The contractors gave bond in the sum of $100,000 for the faithful fulfillment of the terms of the contract. The work of construction will begin within 20 days and the road will be completed and in operation within two years.

TEXAS.—A press report from Corsicana, Tex., states as follows: C. W. Coykendall, a Chicago attorney, is here and says he represents a company of capitalists who will submit a proposition to people here and Corsicana to the South Texas pineries by way of Fairfield. Local capitalists attempted to build this road two years ago, surveying the line to Fairfield, but on account of the stringency in financial affairs they abandoned the project.

TEXAS & PACIFIC COAL.—This company is reported as interested in a railway about to be built from the Palo Pinto coal mines at Thurber, Tex., to Dublin, on the Fort Worth & Rio Grande, a distance of about 45 miles.

Rocky Mt. and Pacific—Existing Roads.

SUMPTER VALLEY.—It is reported probable that this railway will be extended 15 miles further into the Greenhorn country, in Oregon, this summer.

Projects and Surveys.

BLAINE & EASTERN.—Incorporated in Washington to build a railway from Blaine eastward through the Nooksack Valley, by way of Lynden, to a connection with the Lake Shore; capital stock, $400,000; D. B. Jackson, Minneapolis; H. L. Stone, Aurora, Ill.; R. T. Spencer, J. V. Y. Westling, G. H. Heilbron, Seattle; offices at Seattle and Blaine. The road will be about 25 miles in length, and it is stated that the construction will be commenced May 1.

COLUMBIA RIVER.—A press report from Portland, Ore., states as follows: R. W. Baxter, Gen. Supt. of the Union Pacific, has left for Omaha and New York to close up all preliminary matters in connection with the recently incorporated Columbia River R. R. This is the company which proposed to build a railway from Portland to Astoria by way of Goble. Mr. Baxter will see to the signing of the contracts while in the East, and it is expected everything will be settled within five days. Astoria people have succeeded in getting the right of way nearly the entire distance and are now busy finishing up the subsidy of $2,000,000. Upon Mr. Baxter's return actual work on the long-promised road will commence.

EL MORE.—Incorporated in California to build a railway from Goldtree to El More; capital stock, $60,000; incorporators, S. F. Gilmore, A. D. Flagler, G. H. Green, L. C. Branch, San Francisco; W. F. Lakenon, Kansas City, Mo.; principal office, San Francisco.

WHITE & COLUMBIA.—W. B. Allen, Seattle, is reported as stating that a $25,000 issue of bonds has been sold by Gratian H. Wheeler, Chicago, for the construction of this railway from Buckley, Wash., up the White River Valley five miles. Pres., C. N. Joynt, Buckley.

Foreign.

MEXICAN INTERNATIONAL.—A press report from Eagle Pass, Tex., states as follows: A force of engineers has left Reata Station to locate a branch of the Mexican International Ry. from that place to Monterey. Reata is 208 miles south of this place and 5 miles north of Trevino, the junction where the Northern extension of the Monterey & Gulf Ry. connects with the International. The branch will be about 56 miles long. Locating parties will start from Monterey also, so as to insure the completion of the line as quickly as possible.

STREET AND ELECTRIC RAILWAYS.

WENHAM, MASS.—It is reported probable that the Lynn & Boston R. R. will use electricity as a motive power on the Wenham branch.

HARTFORD, CONN.—It is reported from Middletown that the directors of the Boston & New York Inland R. R. Co. met there on Wednesday of this week to consider plans for the construction of an electric road across Connecticut, to have no grade crossings or drawbridges. The bridges over rivers, it is said, will be so high that vessels can pass under them. This company, according to a press dispatch to the Boston "Herald," dates back 10 or 15 years, and has made no movement to do anything in Connecticut since about that time. It then came to the legislature backed by the influence of the late Gov. Marshall Jewell, and asked for a special charter. The legislature refused it, however, on the theory that the enterprise was merely speculative. At that time it was announced that the Connecticut charter was asked for the purpose of a connection with the tracks of a company which proposed to build in Massachusetts, and already had some surveys and plans. However, since the negative action of the Connecticut legislature, the company has made no appearance here.

MIDDLETOWN, CONN.—The Business Men's Association urges the mayor to approve the proposed extension of the Middletown Horse R. R., and the plans for the introduction of the trolley system.

WESTPORT, CONN.—The Norwalk Horse Ry. Co. will equip its road with electricity, the work to be done at once, according to reports.

BROOKLYN, N. Y.—The Nassau Electric R. R. Co. has purchased a site for a power house between 39th and 40th Sts.

NEWBURGH, N. Y.—The council has granted a franchise to the Newburgh Electric Ry. Co.

DELAWARE WATER GAP, PA.—The Mount Minsi Electric Ry. Co. has been incorporated with a capital stock of $125,000 to operate between this place and Mount Minsi. Pres., A. B. Batchelder.

EASTON, PA.—The Easton Transit Co. has awarded the contract for a five-mile extension of its electric railway to the Lehigh Valley Construction Co., South Bethlehem.

LANCASTER, PA.—The Lancaster & New Holland Ry. Co., and the Lancaster & Lititz Ry. Co. have been incorporated; capital stock of each, $100,000. Pres., J. S. Graybill.

LOCK HAVEN, PA.—E. P. Geary, Cy. Clk., informs us that a local street railway company has been formed and $10,000 has already been subscribed. Pres., L. M. Patterson.

YORK, PA.—It is reported probable that the York St. Ry. will be extended to Dover and Dallastown this summer, and that the contract for the Queen St. and Mayersville extension will be let this week.

CENTERVILLE, MD.—It is reported that $50,000 has been subscribed to build the Queen Anne R. R. from this place to Chestertown, for which surveys are now being made. W. W. Bursteed and J. B. Brown are interested.

TOWSONTOWN, MD.—The Randallstown, Harrisonville & Granite Electric Ry. Co. has been incorporated by E. S. W. Choate, J. W. Offutt, H. J. Hebb, G. E. Lynch and others; capital stock, $50,000. The company has asked authority to build an electric railway from Pikesville to Randallstown, a distance of four miles.

PAINT ROCK, ALA.—Press reports state that rest-

dents of the Paint Rock Valley, who have been for several years trying to get a railway through that section have decided to build an electric railway from Bean's Creek, on the Nashville, Chattanooga & St. Louis R. R., to Gurley, on the Memphis & Charleston.

LEXINGTON, KY.—A report from this city states as follows: The proposed electric railway connecting this city and Versailles is in a fair way to be constructed. 'Squire Rice, who has been working on the movement for several months, reports that he has secured the right of way to within one mile of Versailles. He says he can raise at least $5,000 from the farmers residing between the two cities, and that he has been assured by the colored people at Slickaway that each of the 200 men there will contribute a week's work free of charge for the road.

ASH, O.—It is reported that a petition presented to the township board will grant the Detroit & Toledo Electric Ry. Co. the right of way to run its line through the eastern part of the township.

DAYTON, O.—The Dayton Traction Co. has been incorporated with a capital stock of $500,000, to construct an electric railway to Cincinnati; directors, Judge Dwyer, O. B. Brown, Wm. A. Mays, Frederick Retbald, O. M. Gottschalk, Wm. Huffman and Walter Smith. Press reports state that it is the present purpose of the company to build the line from the village of Harshmansville through this city to the south boundary line of Miamisburg. The company has secured the right to carry mail, express matter and freight of every description. For the construction and equipment of the road the company will issue first mortgage 5% 20-year bonds for $300,000. Harshmansville is two miles northeast of Dayton and about 20 miles in a direct line from Springfield, with which city it is the purpose to connect. From Dayton the line will extend to Alexandersonville, to West Carrollton and to Miamisburg. Then it is proposed to come south to Franklin, Middletown and Hamilton and from Hamilton to Cincinnati.

ELYRIA, O.—It is reported that three electric railway companies have been organized and that one of them has secured the right of way for a line to Loraine.

MARION, O.—The Marion St. Ry. Co. has been organized by E. Durfee, Geo. Turner, E. Huber and others, and is arranging with the council for a franchise; capital stock, $100,000.

TOLEDO, O.—It is reported that the right of way for the Toledo & Maumee Electric Ry. Co. has been secured and that the road will be built this summer. Ch. Engr., J. D. Cook, Law Bldg.

CHICAGO, ILL.—The Chicago & Morgan Park Electric St. Ry. Co. has been incorporated to construct an electric railway to the villages of Morgan Park and Blue Island; capital stock, $500,000; directors, B. F. Deacon, C. S. McCoy, S. H. Hubbard, Frank Foster and Ralph F. Boyle, all of Chicago.

GREEN BAY, WIS.—The Fox River Electric Ry. Co. has been incorporated to operate an electric railway in Green Bay, Fort Howard, DePere and the town of Allouez; capital stock, $100,000; incorporators, Jas. H. Elmore, Adam Spuhler and F. A. Hollman.—It is stated that E. P. Morton, New York, will construct an electric railway in this city, the road to be in operation within two months.

OSHKOSH, WIS.—J. K. Tillotson, Toledo, O., is reported as having petitioned for a franchise for an electric street railway.

SIOUX CITY, IA.—The cable railway company is reported to have deposited $55,000 to change the line to an electric railway.

HOT SPRINGS, S. DAK.—J. M. Metcalf and others have petitioned for a franchise for an electric street railway two miles in length.

NIAGARA FALLS, ONT.—The Niagara Falls Park & River Ry. Co. will build an incline railway to the Maid of the Mist landing on the Canadian side of the Niagara River, according to reports. William Osborne, Engr.

HIGHWAYS.

PENNSYLVANIA.—G. C. MacGregor, Engr., writes us that work on the boulevard, 7½ miles long, to be constructed between Elmhurst and Scranton, Lackawanna county, was commenced April 2, by the contractors, Mairs & Lewis, New York, with a force of 100 men. They will increase this to about 250 and complete the work by August 1.

WISCONSIN.—The people of Columbia county have met in Columbus and adopted plans for macadamizing the main roads that lead into that city.

MINNESOTA.—The residents of St. Louis county have petitioned the board of commissioners for the improvement and construction of more highways. G. W. La Vaque, County Aud., Duluth.

KANSAS.—The state board of agriculture will petition the legislature for the improvement of more county roads throughout the state, according to press reports.

MISSOURI.—A highway nine miles long is to be constructed from Kansas City to Hickman's Mills, Jackson county.

BRIDGES AND TUNNELS.

GEORGIA, VT.—The contract for the bridge on the Central Vermont R. R., at this place, has been awarded to the Pencoyd Bridge Co. The bridge will have three deck lattice spans of 155 ft., covered with Thomson's solid rail floor and rock ballast, according to the designs of G. H. Thomson, Consult. Engr., Central Vermont R. R.

BOSTON, MASS.—The park commissioners will receive bids until April 16 for a stone bridge at Forest Hills entrance to Franklin Park.

NEW YORK, N. Y.—Bids are asked until April 28 for the construction of a steel and iron foot bridge from Goat Island to Luna Island, in the state reservation at Niagara. Archs., Vaux & Co., 74 Bible House, A. H. Green, Pres. Comrs., 214 Broadway.

PHILADELPHIA, PA.—A bill has been introduced in the senate authorizing the Philadelphia & Camden Bridge Co. to construct a bridge across the Delaware River at this city.

PITTSBURG, PA.—Bids are asked until April 14 for the superstructure and masonry of five wrought iron through plate-girder highway bridges, and for the construction of two stone arch bridges. Jas. A. Grier, county controller.—The director of public works will soon ask for bids for a bridge at South 22d street, according to reports.

WASHINGTON, D. C.—The senate district committee has voted in favor of the bill providing for a survey for a bridge across the eastern branch of the Potomac. The bill appropriates $5,000 for the purpose of a survey, and as amended by the committee, leaves to the secretary of war the exact location of the bridge.

HYATTSVILLE, MD.—The committee has recommended that an iron bridge be built across the stream from this place to Bladensburg, at an estimated cost of about $5,000.

AUGUSTA, GA.—A new iron bridge will soon be built at Greene and 15th Sts., at a cost of $8,000, according to reports.

GRENADA, MISS.—The supervisors of Grenada county have contracted with the King Bridge Co. for a $20,000 steel suspension bridge in the eastern part of this city.

MILWAUKEE, WIS.—G. H. Benzenberg, Cy. Engr., writes us that the contract for the folding or lift bridge will be awarded April 16. The bids received last month for this work were published March 22.

SIOUX CITY, IA.—The following bids have been received for constructing new pile bridges in one district: Chas. Stewart, Salix, $2.75 per ft.; N. A. Holbron, Smithland, $3.95; R. S. Hammond, Lakeport, $3.00; Ford & Conlin, Sioux City, $6.75; Smith & Conlin, Sioux City, $6.40; T. F. Jones, Moville, $4.15; A. Gilpin, $4.20; Ben Glover, Sloan, $3.15; T. F. Harrington, Moville, $4.25.

DULUTH, MINN.—After many unsuccessful attempts two bills for bridging the St. Louis River at this city have finally passed the house. No opposition is anticipated for the bills in the senate.

RED WING, MINN.—Bids are asked until April 20 for $70,000 of bonds for the proposed highway bridge across the Mississippi River. W. E. Taylor, Cy. Clk.

TACOMA, WASH.—The contract for the Eleventh St. bridge has been awarded to the King Bridge Co., at $79,686. This was the fourth time that bids have been received for this bridge. The bids received at the third opening were published March 29.

WATER-WORKS.

AUBURN, ME.—The city has purchased 400 tons of pipe for extensions.

BELCHERTOWN, MASS.—G. W. Longley, Tn. Clk., writes us that the bill authorizing works is still pending in the legislature. The works will probably be a gravity system, but no engineer has yet been employed.

DALTON, MASS.—Press reports state that a 28,000,000-gallon reservoir will be built and the mains extended.

GREENFIELD, MASS.—Percy Blake is reported to have completed specifications for a stone dam for a proposed new reservoir, but it is stated that the present dam may be raised 10 ft. and the more extensive improvements postponed.

HUDSON, MASS.—We are informed that the town has voted not to make the proposed extensions this year.

LEICESTER, MASS.—The contract for laying the 15,000 ft. of extensions to Cherry Valley, has been awarded to Mr. Hennessey, of Holden. The work includes 25 hydrants. L. D. Thurston, town clerk.

NORTHAMPTON, MASS.—The bids received for the proposed masonry dam, 400 ft. long and 45 ft. high, were considered too high, and it is stated that the specifications will be changed and the work readvertised. The bids were as follows: Troy Public Works, Troy, N. Y., $53,715; Geo. M. Atkins & Co., Palmer, $53,365; H. A. Wright, Springfield, $53,240; W. H. Ward, Lowell, $54,050; Fred T. Ley & Co., Springfield, $56,290; Morse, Lewis & Hodge, New York, $54,016; Latham & Mulcahy, Northampton, $49,590.

ROCKLAND, MASS.—The town has appropriated $7,000 for a new pump for the works.

ROCKPORT, MASS.—The legislative act giving the town the right to take Cape and Mill Brook ponds for a supply and to construct works has been unanimously accepted.

WESTFIELD, MASS.—L. F. Thayer is a member of a committee appointed to consider the question of an increased supply.

NEW LONDON, CONN.—The commissioners have recommended the building of a new reservoir with a capacity of 152,000,000 gallons.

ALBANY, N. Y.—Bids are asked until April 17 for the laying of 20 and 12-in. extensions and for replacing old mains with new ones in several streets. Geo. I. Bailey, Supt.

COLD SPRINGS, N. Y.—The Cold Springs & Nelsonville Water-Works Co. has been incorporated with a capital stock of $50,000.

FORESTVILLE, N. Y.—The village trustees have called an election for April 24, to vote on the question of works. The village is free from debt and it is thought that works can be put in for $12,000.

FRANKFORT, N. Y.—We are informed that the following bids were received for constructing the proposed works:

Bidders.	Piping system.	Supply system.
Eldridge & Fogg	$20,370	$22,448
E. Fitzgerald & Sons	21,300	21,000
Inman Bros. Constn. Co.	20,700	22,000
S. C. Ferguson	24,450	.....
Joseph Gallo	22,526	27,367
W. B. Birdseye	20,615	17,852
Flood & Sherrill	22,805	22,183
Morgan & Sears	25,724	.....
Troy Public Works Co.	21,000	21,500
Michael Bennett	25,773	.....
P. H. Harrison & Sons	21,930	.....
L. J. Richardson	22,218	.....
John Morrell	22,712	.....
Beckwith & Quackenbush	25,631	19,603
Halliman Bros. & Fenton	22,960	28,500
John H. Nelson	20,790	22,470
John Marsden	21,341	19,070

MONTICELLO, N. Y.—It is stated that the town wishes to grant a franchise. Address D. S. Avery.

PENN YAN, N. Y.—Wm. D. Dwelle, Clk., writes us that the proposed works will probably cost about $55,000, but that it is impossible to state when bids will be received as the commissioners have not yet organized; supply from Keuka Lake; population, 4,800. —— The bill granting authority to construct water-works and sewers has been signed by the Governor.

ROCHESTER, N. Y.—The House has passed a bill authorizing this city to issue $200,000 of bonds for additional water mains.

ASBURY PARK, N. J.—The commissioners have asked that $50,000 in bonds be issued for increasing the supply; proposed work including new wells, pumping station, filter, and probably a compressed air plant to increase the supply.

ATLANTIC CITY, N. J.—Ordinances have been passed authorizing an issue of $700,000 of 5% bonds to purchase the two local plants. The first attempt to buy the works was set aside by the supreme court because members of the council voting were stockholders.

BLOOMFIELD, N. J.—There is talk of forming a company with $200,000 of capital stock to put in new works. Address J. A. Peloubet.

MATAWAN, N. J.—Wm. Rodgers, Tn. Clk., writes us that an election will be held May 26, at which the question of works may be decided.

ANNAPOLIS, MD.—Wm. A. Hanway, G. H. Rice, J. I. Yellott and others have petitioned the legislature for a charter for the Lawson Water Co.

NORFOLK, VA.—The council has voted to contract with the Ray Artesian Well Co. for a daily supply of 5,000,000 gallons at a cost of $65,000.——It is thought that the proposed supply from the Dismal Swamp would cost $400,000.

WINCHESTER, VA.—Alexander Potter, Engr., Pittsburg, writes us that contracts have been awarded as follows: Pumping machinery, F. R. Dravoe & Co. (Nordberg), $5,750; pipelaying, John DeGalliford, $11,170; reservoir, John Seabright, $3,400; cast iron pipe and specials, Glamorgan Co., $11,727; hydrants and valves, R. D. Wood & Co., $1,250. The bids received for the pumping engines will be published next week.

GREENSBORO, N. C.—It is reported that work will soon be commenced upon proposed extensions.

NEWBERRY, N. C.—C. A. Bowman, Clk. of council, writes us that J. W. Baum, Aiken, S. C., has made surveys and is now preparing specifications for works; supply from artesian well; population, 3,500.

AIKEN, S. C.—Bids are asked until May 15 for the construction of works; supply from artesian well; population, 3,000. Engr. in charge, L. J. Barbot, Augusta, Ga. H. Busch, Chn. Com.

COLUMBUS, GA.—M. M. Moore, Cy. Clk., writes us that there has been talk of buying the present works or of constructing new ones and that a survey has been made, but it is doubtful if any further action will be taken at present.

COLUMBIA, ALA.—It is stated that the city intends to contract for the construction of new works. Address Geo. L. Campbell.

MIDDLESBORO, KY.—The Middlesboro Town Co. is reported as about to resume the construction of its proposed works.

ASHTABULA, O.—The present service is unsatisfactory and the council is discussing the question of a municipal plant.

CINCINNATI, O.—The board of administration will receive bids until May 3 for pipe, castings, and other supplies.

MANSFIELD, O.—The vote on the proposed bond issue failed to secure the necessary two-thirds majority, and the projected improvements have been postponed.

STEUBENVILLE, O.—The city has voted, 2,033 to 410, in favor of the proposed issue of $175,000 of bonds for new works.

KNIGHTSTOWN, IND.—Bids are asked until April 25 for constructing works, including pumping machinery, stand-pipe, and furnishing and laying 22,775 ft. of 10 to 4-in. pipe. J. H. Cunningham, Chn. Com.

ARMADA, MICH.—There is talk of putting in works, according to reports.

HARRIETTE, MICH.—A company is being organized to build a dam in Slagle Brook to secure ice and a water supply for fire protection.

KALAMAZOO, MICH.—It is stated that a high water tower will be erected at the insane asylum.

McBAIN, MICH.—The question of works is being agitated, according to reports.

CHICAGO, ILL.—Bids are asked until April 18 for furnishing about 10,000 of ⅝ and ¾-in. screw ferules and 5,000 of ¾-in. drive ferules. H. J. Jones, Comr. Pub. Wks.

DUNDEE, ILL.—The city clerk writes us that nothing will be done for works until the new village boards are organized.

GARDNER, ILL.—The question of works is again being considered, and it is reported probable that it will soon be voted upon by the citizens.

ASHLAND, WIS.—The city attorney has been ordered to bring suit against the water company to annul its franchise, owing to the impure supply which it has been furnishing.

MILWAUKEE, WIS.—The city engineer estimates that it will cost about $70,000 more to complete the new intake tunnel and that the work will be completed this year.

REEDSBURG, WIS.—The ticket favoring works was elected April 3. C. C. Stevens, Cy. Clk.

WAUPUN, WIS.—Further investigations as to the best plan for works are to be made. R. H. Oliver, Cy. Clk.

DYERSVILLE, IA.—D. A. Gherig, mayor, is interested in a company that is being organized to put in works. A franchise has been granted; supply from wells; population, 1,500.

JEFFERSON, IA.—M. E. Hall, Clk., writes us that no engineeer has yet been employed for proposed works; supply from well 2,200 ft. deep; population, 2,500.

RED OAK, IA.—Bids are asked until April 25 for

one 1,000,000-gallon compound pumping engine, 3,500 ft. new mains, 20 × 100-ft. stand-pipe, 5 hydrants and 19 valves; estimated cost, $14,000. Engr., F. L. Burrell, Tremont, Neb. R. O. Newell, Cy. Clk.

SHELDON, IA.—Bids are asked until April 20 for the construction of works estimated to cost $16,000.

DULUTH, MINN.—A correspondent writes us that the plans recently made by the city engineer for works include two 5,000,000-gallon and one 10,000,000-gallon pumping engines, a 42-in. cast iron intake and six miles of 36-in. cast iron mains, and that the work will probably be commenced as soon as some minor matters relative to the $800,000 of bonds issued for this purpose have been settled. It will take two years to complete the works.

MINNEAPOLIS, MINN.—The city engineer has reported that the proposed submerged pipe in the river at 32d Ave. would cost $17,000.

NEW PAYNESVILLE, MINN.—Bids are asked until May 7 for the sale of $2,500 of water-works bonds. A. T. Watson, Village Recdr.

NORTHFIELD, MINN.—The mayor has recommended the construction of works.

FORT SCOTT, KAN.—Chas. T. Coffin, Chicago, has been appointed receiver of the Fort Scott Water-Works Co.

FRIEND, NEB.—The contract for works has been awarded to the Fremont Foundry & Machine Co., Fremont, at $16,075.——The $18,000 of 6% bonds were sold at 2% premium.

TECUMSEH, NEB.—Geo. Scott, Cy. Clk., writes us that no definite steps have yet been taken for works.

WAKEFIELD, NEB.—The city is negotiating the sale of $7,000 of bonds to construct works.

MADISON, S. DAK.—The water-works bonds have been sold and the construction of the proposed works will be commenced at once, according to reports; works include stand-pipe.

BUFFALO, WYO.—W. H. Fenn, Cy. Clk., writes us that the following bids were received for constructing the proposed gravity system of works: Seckner Contracting Co., Chicago, 15,130 ft. of steel pipe and balance of kalamein, $56,000; Chas E. McGarvey, Cheyenne, 15,130 ft. steel, balance kalamein, $39,107 (awarded contract); 15,130 ft. cast iron, balance kalamein, $37,731; all riveted wrought iron, $36,950; all cast iron, $47,500; 15,130 ft. cast iron, balance spiral riveted, $37,933.

POPLAR BLUFF, MO.—The city has sold $20,000 of water-works bonds for $20,965.

HENNESSEY, OKLA.—The citizens recently voted $10,000 in bonds for works and it is reported that the construction will be commenced at once.

SPRINGER, N. MEX.—The Springer Water & Electric Light Co. has been incorporated by C. J. Marks, P. P. Talle, W. C. Lute and M. M. Salazar; capital stock, $25,000.

EVERETT, WASH.—The proposition to issue $140,000 of bonds to purchase the works was defeated by a vote of 397 to 92. After the election had been called the water company wished to withdraw its offer to sell, which was agreed to, according to reports.—— Ellis Morrison, Seattle, has petitioned for a franchise to put in private works.

NEW WHATCOM, WASH.—The council has decided in favor of additional extensions estimated to cost $9,000.

GRANT, ORE.—The "Gazette" is urging that works be constructed.

PORTLAND, ORE.—There were 22 bids received for constructing the proposed reservoir, ranging from $26,632 to $65,047, and all were rejected. The specifications will be changed and the work readvertised.

OAKLAND, CAL.—The contract for digging the trench to Alvarado, 17 miles, for the Alvarado Water Co. has been awarded to K. G. Easton. The ditch will be 3½ ft. wide and 5 ft. deep, and will cost from $12,000 to $15,000. The contract for pipelaying has been awarded to Francis Smith.

VISALIA, CAL.—The Visalia Water Co. has been incorporated by W. H. Hammond, D. G. Overall, Arthur Crowley and others; capital stock, $100,000.

CAMPBELLTON, N. B.—The council has voted to exempt from taxation for 10 years any company that will put in works.

MONTREAL, QUE.—Bids are asked until April 17 for a double horizontal turbine and power pumps. A. Davis, Supt.

ARTESIAN WELLS.

CAMDEN, N. J.—The committee has voted to ask for bids for sinking two 8-in. artesian wells. It is thought that 75 6-in. wells would be required to secure sufficient supply of artesian water for the city. Wm. J. Mines, Supt.

ALEXANDRIA, S. DAK.—There is talk of issuing bonds for an artesian well.

NEW MEXICO.—A press report states as follows: Mr. Harold, of Pittsburg, Pa., has a contract to sink 10 artesian wells in south Santa Fe county, New Mexico, for the Hydraulic Placer Mining & Irrigation Co., of New York. He has five carloads of machinery and is prepared to surmount all obstacles in securing water for operating the thousands of acres of placer gravel in south Santa Fe county. He will sink wells 3,000 ft. deep in hopes of striking artesian water, but if this fails to flow then a series of wells will be put down and pumps used to lift the water into elevated reservoirs.

MEDFORD, ORE.—J. T. Flynn, of the Pacific Well-Drilling Co., Portland, has offered to sink a 12-in. well 500 ft. deep for $3,500, and it is reported probable that the council will accept the proposition.

TORONTO, ONT.—It is proposed to sink an experimental artesian well at Eglington, to cost $3,000.

IRRIGATION.

O'NEILL, NEB.—A press report gives the following information: The Niobrara River Irrigation & Power Co. held a meeting April 2 to hear the report of D. W. Campbell, the engineer employed at the interstate irrigation convention to go over the route of the proposed canal. Mr. Campbell reports the proposed route of the company's canal perfectly practicable and feasible, which is much better than had been anticipated. The estimated cost of construction is $1,000,000, outside figure. The report being so favorable, the company went right to work on plans and perfected an organization, electing the following officers: Pres., A. U. Morris; Vice-Pres., J. P. Mann; Secy., T. V. Golden; Treas., John McHugh. The company proposes to float bonds as soon as possible and to commence work on the construction of the canal at once.

SEWERS.

LITTLETON, N. H.—G. H. Allen, Engr., Manchester, writes us that about 4,000 ft. of 12-in. sewer will probably be laid early this season.

WOODSVILLE, N. H.—It is reported that an engineer will be engaged to make plans for extensions of the system.

CLINTON, MASS.—The town will vote on issuing $5,000 in bonds to extend the system, according to reports.

GREENFIELD, MASS.—It is reported that the town has voted to adopt a system.

HOLYOKE, MASS.—The committee has reported that it will cost about $100,000 to complete the proposed system.

NATICK, MASS.—The town has voted to construct a sewerage system to cost about $150,000.

PITTSFIELD, MASS.—It is proposed to appropriate $31,000 for constructing sewers.

WELLESLEY, MASS.—The committee estimates the cost of the proposed system to be $150,000.

WOBURN, MASS.—The council is considering the question of sewers to be constructed this year.

CENTRAL FALLS, R. I.—The commissioners have recommended that the filtration plan be adopted for sewage disposal.

DANBURY, CONN.—It is reported that bids will soon be asked for constructing a sewer in State St., to cost about $9,000, plans for which are being made by the city engineer.

WATERBURY, CONN.—The city engineer has estimated the cost of a proposed sewer at $9,300, and the commissioners have recommended that the construction be commenced at once.

BUFFALO, N. Y.—Bids are asked until April 19 for constructing 15 to 10-in. brick sewers in two streets. J. E. Ransom, Secy. Dept. Pub. Wks.

GENEVA, N. Y.—An election will be held April 17 to vote on the question of construction of an outlet sewer, to cost about $10,000. Engr., J. J. R. Croes, New York. D. B. Backentose, Pres. Comrs.

NEW YORK, N. Y.—Bids are asked until April 17 for constructing a sewer in Washington St., and an outlet sewer in Wolf St. L. F. Haffen, Comr., 2622 Third Ave.——Plans are being prepared under the direction of Louis F. Haffen, Comr., for 3½ miles of 16-ft. brick sewer, estimated to cost $500,000. The sewer will extend in Broadway from the city line to the Harlem River and will drain 2,292 acres.——It is stated that Commissioner Haffen will soon have plans completed for a sewer, estimated to cost $250,000.

ROCHESTER, N. Y.—The contract for constructing the State Hospital and Goodman St. sewers has been awarded to John Mander, at $28,207; estimated cost, $37,000. Brayer & Albaugh bid $29,879.

SAYVILLE, N. Y.—The question of sewers is being agitated, and it is reported probable that a private company will be organized to put in a system.

UNION HILL, N. J.—Robt. Gaw, Chn. Com., writes us that it is proposed to build 6,300 ft. of 48 to 24-in. brick sewers; average cut, 18 ft.; estimated cost, $170,000. It is thought that bids will be opened this spring, but the bonds have not yet been sold.

JERMYN, PA.—It is reported that this place is agitating the question of sewers.

MEADVILLE, PA.—It is proposed to construct sewers in eight streets, including a sewer in Park Ave. to cost about $20,000.

WASHINGTON, D. C.—Bids are asked by the district commissioners until April 21 for furnishing sewer pipe.

BRIDGEPORT, W. VA.—The city has voted to issue $25,000 of bonds to construct a system.

SISTERVILLE, W. VA.—G. B. Siemaker, Cy. Clk., writes us that contracts for building three miles of pipe sewer will be let in about two weeks.

MACON, GA.—Gaboury & Noble have awarded contracts for materials as follows: H. Stevens' Sons will furnish about 222,000 ft. of pipe; C. J. Toole, 1,000,000 brick; C. D. Findlay, castings and iron steps for 640 manholes; Kershaw & Hill, cement.

ST. AUGUSTINE, FLA.—A committee has been appointed to secure plans and estimates for a sewerage system.

NASHVILLE, TENN.—J. A. Jowett, Cy. Engr., informs us that contracts have been awarded for building brick sewers as follows:

Contractor.	Size.	Length.	Av. cut.	Price.
Feb. 27.				
J. A. Webb	30 and 48 ins.	2,440 ft.	11 ft.	$7,058
W. R. Dale	42 ins.	1,040 ft.	8 ft.	2,300
David Gordon	30 and 36 ins.	1,868 ft.	½ ft.	4,711
March 6.				
Jno. Broderick	42 ins.	500 ft.	3½ ft.	1,087
Barnesfield & Deaderick	36 ins.	464 ft.	7 ft.	1,119
W. R. Dale	36 ins.	700 ft.	3½ ft.	1,663
W. R. Dale	30 ins.	720 ft.	4½ ft.	1,273
April 5.				
J.E.Lesueur&Co	108 ins.	1,056 ft.	12 ft.	11,500

CINCINNATI, O.—Bids are asked by the board of administration until April 26, for constructing sewers in four streets.

RIVERSIDE, O.—Bids are asked until May 7 for the sale of $10,000 of bonds for sewer and street improvements.

SANDUSKY, O.—Bids are asked until May 5 for constructing a sewer. A. W. Miller, Cy. Clk.

HUNTINGTON, IND.—Bids are asked until April 28 for constructing 18 to 12-in. brick sewers in five streets. H. H. Wagoner, Cy. Engr.

BELLEVILLE, ILL.—Fred. Daab, Secy. St. Com., writes us that one mile of 42 to 36-in. brick sewer is to be built; average cut, 15 ft.; estimated cost, $30,000; and 20 miles of 24 to 8-in. pipe sewer; average cut, 18 ft.; estimated cost, $100,000. It has not been decided when bids will be received for the work.

CHICAGO, ILL.—Bids are asked until April 17 for laying drains in three streets. H. J. Jones, Comr. Pub. Wks.

MILWAUKEE, WIS.—Contracts have been awarded for sewers as follows: 2,500 ft. of pipe sewer in Glen Ave. to Nichol Forrestal, at $1.33 per ft.; 2,221 ft. of pipe sewer in 22d St. to Valt. Dergolt, at $1.27; 1,996 ft. of pipe sewer in three streets to Robt. Chambers, at $1.22; and 1,081 ft. brick sewer in Aner Ave. to Val. Hartmann, at $3.33 per ft.

SAN MATEO, CAL.—A committee is reported as preparing plans for a system.

SALT LAKE CITY, UTAH.—The committee has recommended that the gravity sewer be completed from the outlet to State and Fifth South Sts., at an estimated cost of $267,000, including farm, settling tanks, etc.

STREETS.

CAMBRIDGE, MASS.—It it proposed to appropriate $35,000 for paving with granite.

ALBANY, N. Y.—Bids are asked until April 20 for work in Elberon place and for laying plank walks in Main street. T. J. Lanahan, Clk.——The contract for paving Hawk St. with granite has been awarded to R. H. Strong at $16,432; the other bids being J. J. Cuddy, $17,228; George Holler, $16,431; P. H. Reilly, $17,055.

BROOKLYN, N. Y.—Bids are asked until April 18 for furnishing sand and cobblestones, and for excavating and hauling sand. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until April 19 for furnishing sand and Medina sandstone paving blocks. J. E. Ransom, Secy, Dept. Pub. Wks.——The contract for paving Kensington Ave. has been awarded to the Barber Asphalt Paving Co., at $165,544. This company also received the contract for paving Thomas St. with German rock asphalt, at $12,709.

JAMESTOWN, N. Y.—W. B. Landreth, Engr. Bd. Pub. Wks., writes us that the contract for 44,000 sq. yds. paving with Jamestown brick, 1,000 sq. yds. with Medina stone blocks, and for 16,000 lin. ft. of Peninsula curbing, has been awarded to the lowest bidder, O. N. Gardner, at $88,000.

NEW YORK, N. Y.—Bids are asked by the department of public works until April 18 for paving four streets with asphalt or concrete.——Bids are asked by the commissioner of street improvements, 2,622 Third Ave., until April 17, for paving with granite, and laying crosswalks on three streets.——Geo. C. MacGregor, Engr., writes us that work on the Park Ave. improvement was commenced by the contractors, Mairs & Lewis, 18 Broadway, April 10. They will employ a force sufficient to complete the contract at the date fixed. Two consignments of Georgia pine have been received and are being hauled to the site of the work.

SARATOGA SPRINGS, N. Y.—Cramer & Eldridge Engrs., are preparing plans for about 4,000 sq. yds. of brick paving.

WHITE PLAINS, N. Y.—Authority will be asked to bond the village for $31,000 for paving one-half a mile of Railroad Ave. with asphalt.

ALLEGHENY, PA.—The council is reported as in favor of issuing $500,000 of bonds for street improvements.

ALLENTOWN, PA.—L. J. H. Grossart, Cy. Engr., writes us that bids are asked until May 1 for paving 1,766 sq. yds. with macadam.

PITTSBURG, PA.—Contracts for paving 17 streets with asphalt have been awarded to Booth & Flinn, the lowest bidders, at $379,737. It is stated that about $1,000,000 will be spent this year for paving.——Bids are asked until April 14 for repaving 35 streets with asphalt or stone. E. M. Bigelow, Dir. Dept. Pub. Wks.

WILLIAMSPORT, PA.—H. C. Reeder, Cy. Engr., informs us that the contract for paving William street with asphalt has been awarded to the Sicilian Asphalt Paving Co., New York.

BALTIMORE, MD.—It is proposed to pave 15 streets with macadam, asphalt, or stone.

SISTERVILLE, W. VA.—G. B. Siemaker, Cy. Clk., writes us that about $6,000 worth of brick paving will be laid as soon as the proposed sewer work is finished.

JACKSONVILLE, FLA.—The council has voted to pave Bay St. with brick.

MONTGOMERY, ALA.—D. W. Ford, Comr. of Streets, writes us that bids are asked until April 16 for 35,330 sq. yds. of paving with granite, brick, or asphalt.

FORT WAYNE, IND.—Bids are asked until April 24 for grading and repaving eight streets with brick. F. M. Randall, Cy. Engr.

HUNTINGTON, IND.—Bids are asked until April 28 for paving Jefferson St. with brick. H. H. Wagoner, Cy. Engr.

BELLEVILLE, ILL.—Fred. Daab, Secy. St. Com., writes us that bids will probably be opened in July for paving with brick.

LA GRANGE, ILL.—About $100,000 is to be expended in paving streets this season. Engrs., Alexander, Hill & Enriebt, Chamber of Commerce Bldg., Chicago.

PEKIN, ILL.—U. J. Albertsen, Chn. St. Com., writes that it is proposed to pave 12,000 sq. yds. with brick to cost $20,000. The court met April 9 to confirm the assessment for this purpose.

OSHKOSH, WIS.—A contract for paving has been awarded to John Martin at about $28,000.

MUSCATINE, IA.—It is proposed to pave two miles of streets with brick, at an estimated cost to the city of $20,000 to $30,000.

WATERLOO, IA.—Bids are asked until May 7 for 13,500 sq. yds. of paving with brick. H. C. Schultz, Cy. Clk.

PORTLAND, ORE.—It is stated that considerable brick paving will be done this season.

SAN JOSE, CAL.—It is proposed to improve 12 streets.

SALT LAKE CITY, UTAH.—The city engineer has made plans and estimates for paving the sidewalks of

Second East St., with flagstone $31,360, or $17,920 with cement.

TORONTO, ONT.—The city engineer recommends the paving of Parliament St. with asphalt; estimated cost, $25,400.

ELECTRIC LIGHT AND POWER.

NEWTON, N. J.—Bids are asked until April 14 for lighting the streets with not less than 62 electric lights of 800, 1,200 and 1,600 c. p. P. S. Decker, member of committee.

McKEESPORT, PA.—The contract with the McKeesport Light Co. expires in June, when it is reported probable that the Westinghouse Co. will put in a plant and will furnish each lamp at $75 per year, instead of $100, the present price.

COLUMBIANA, O.—It is reported that the people will vote on bonding the town for an electric light plant at the spring election.

GEORGETOWN, O.—Authority has been asked to build an electric light plant to cost $10,000.

LANSING, MICH.—Bids are asked until April 20 for constructing an electric light power-house. Daniel Barringer, Secy. Comrs.

LANCASTER, WIS.—Aug. Michaelis, Cy. Clk., writes us that a home company has been formed and is waiting for a franchise to put in a plant.

MINNEAPOLIS, MINN.—F. W. Cappelen, Cy. Engr., informs us that the proposed bond issue of $160,000 for an electric light plant is delayed pending a decision of the supreme court of the case in June.

O'NEILL, NEB.—It is reported that the council is considering the purchase of the electric light plant.

AUSTIN, TEX.—The Fort Wayne Electric Co., Fort Wayne, Ind., has closed a contract for constructing the electrical distribution system. The public lighting will be by the tower system.

DALLAS, TEX.—Bids for erecting the electric light plant have been received as follows: Westinghouse Electric & Mfg. Co., $42,000; Owen Ford, $24,990; Dallas Electric Co. (for lighting city), 200 lights at $125 per light per year; Western Electric Co., $36,462; E. J. Spencer, $43,550; D. A. Tompkins, $42,565.

TORONTO, ONT.—The city engineer has been directed to secure estimates and plans for a lighting plant. The contract with the Toronto Electric Light Co. expires in 1895, and the city is reported as at present paying $107,774 a year for 1,000 lights.

NEW COMPANIES.—Mercantile Electric Co., New York, N. Y.; $5,000; its purpose is to construct and maintain lines of telegraph and telephone from 120 Broadway; H. A. Hulbut, Lyman Rhodes, H. S. Terbell, G. W. Phillips.——Falls Electric Light Co., Williamsport, Ind.; $6,000.——Adel Electric Light Co., Adel, Ia.; $14,800; Pres., G. W. Porter; Secy., M. S. Ish.; Tres., W. W. Steele.——Chestertown Light & Power Co., Chestertown, Md.——Bessemer Light, Heat & Power Co., Braddock, Pa.; $10,000; Tres., N. L. Crabbe, Pittsburg; Josiah Barrett, Allegheny; J. P. McKelvy, Braddock, Pa.; C. F. Ellis, Swissdale.——Sach's Electric Co., New York, N. Y.; $20,000; T. L. Peters, C. T. Haviland, F. Forbes.——Light, Heat & Power Co., Fishkill, and Matteawan, N. Y.; $40,000; W. D. Haven, Trenton, N. J.; W. R. Schofield, W. W. Silkworth, Fishkill Landing, N. Y.; A. M. Sutherland, Orange, N. J.; T. G. Strong, Bay Shore, N. Y.——Ste. Genevieve Brewing & Lighting Association, Ste. Genevieve, Mo.; $30,000; Henry Rosler, W. W. Wilder, Valentine Rottler.——Automatic Electrical Specialty Co., Newark, N. J.; $10,000; L. J. Anerbacaher, August Begerow, Herman Schulz, Newark, N. J.

CONTRACT PRICES.

CASTINGS.—Meriden, Conn.—The sewer committee has awarded a contract for 64,000 lbs. of castings to Pratt & Cady, Hartford, at 1.46¼ cts. per lb.

Earth excavating, 3,140 cu. yds., at 13 cts.; pine boards, 85,328 ft., $11.75; pine strings, $15; paving, 9,481 sq. yds., 43 cts.; stone curbing 5,240 ln. ft., 38 cts.; stone curves, 28, at $2; iron catch basins, 12, at $36; oak headings, 420 lin. ft., 16 cts.; 8-in. sewer, 450 lin. ft., 18 cts.

BRICK PAVING.—Louisville, Ky.—Chas. V. Mehler, Ch. Engr., writes us that contracts for vitrified brick or block paving laid on 6 ins. concrete with joints filled with bituminous paving concrete have been awarded at $1.46 per sq. yd., the work to be guaranteed and kept in good repair for five years.

Jamestown, N. Y.—The "News" states that the bids per sq. yd. received for 44,000 sq. yds. of brick paving were as follows, the price in the second column being per lin. ft. for 16,000 ft. of curbing:

Rider & Fitzgerald, Dunkirk	$1.04	$0.55
Park Paving Co., Rochester, Pa	.86	.55
John Osborn, Franklin, Pa	.93	.52
Dunn Bros., Scranton, Pa	.79	.50
T. B. Townsend Co., Zanesville, O	.95	.52
W. H. Mandeville, Olean	.95	.55
Souders & Houston, Pittsburg	.96	.69
McNaughton & Deutro	.85	.52
Louis H. Gipp, Tonawanda	1.03	.60
J. B. Bates, Jamestown	.81	.55
Erbeck Bros., Homestead, Pa	.95	.58
O. N. Gardner, Jamestown	.81	.45
E. M. Ayers, Zanesville, O	.92	.48
Standard Const'n Co., Pittsburg	.99	.50
Northern Ohio P. & C. Co., Cleveland	1.00	.47
Homer & Co., Olean	.95	.75

Peoria, Ill.—Jacob A. Harman, Cy. Engr., writes us that contracts were awarded March 28 as follows: Jefferson St., with one course 2×4×8-in. brick on 6 ins. broken stone concrete, to Casgrain & McDonald, Chicago, at $1.47½ per sq. yd., excavation 17 cts. per cu. yd., curb setting 5 cts. per lin. ft.; Bridge St., with one course 4×5×12-in. brick on 6 ins. gravel, to Robt. Clark, Peoria, at $1.47 per sq. yd., excavation 25 cts. per cu. yd., resetting curb 5 cts. per lin. ft.; Lincoln Ave., with one course 4×5×12-in. brick on 5 ins. gravel, to J. S. Allen, Peoria, at $1.47 per sq. yd., excavation 23 cts. per cu. yd., curb setting 6 cts per lin. ft.

La Porte, Ind.—W. J. Vogt, Cy. Clk., writes us that the contract for brick paving, recently noted, has been awarded to De Frees & Nelson, South Bend, at $1.43 per sq. yd. for Canton standard brick. Bids were received on 21 different qualities of brick. The work will include a foundation of 6 ins. of crushed limestone and 2 ins. of sharp sand and the laying of a single layer of brick, perfectly straight, on edge, end to end, at an angle of 45° to the curb line. The other bidders were as follows: McNaughton & Hallwood, Columbus, O.; J. B. Closser, La Porte, Ind.; A. F. Nims, Elkhart; M. J. LaBounty & Co., Chicago; Talbot Paving Co., Chicago; Mall & Doane, Aurora, Ill.; McGillicuddy Bros. & Lemster, Valparaiso, Ind.; J. I. and C. W. McKinney, Toledo, O.; L. T. Harding & Sons, La Porte; B. Malm, La Porte; Lally & Phillips, Portland, Ind.; John Lehman & Co., Chicago; Ohmling & Snyder, Michigan City; Maloney, Jamison & Maloney, Bellaire, O.

SEWERS.—Malden, Mass.—Bids were opened March 29 for about 18 miles of pipe sewers, the bids for sections 1 to 4 are given below and the total amounts for the other sections were as follows: J. N. Drew & Co., $33,737 for sections 5 to 7 and $32,546 for sections 8 to 10; National Construction Co., $42,399 and $41,493; Metropolitan Construction Co., $36,193 and $35,580; Jos. Long & Co., $25,352 and $26,615; Jas. Heath & Son, $26,411 and $25,976; A. W. Bryne, $29,378 and $28,857; Weaving, Booth & Co., $38,576 and $37,346; John Sheehan, no total given and $28,774; Lucian A. Taylor, $33,384 and $31,647; Jere Cashman, no total given and $36,183; Jennis O'Connell, $38,158 for 5 to 7; W. G. Cook, $27,578 for 8 to 10. G. A. Wetherbee, Cy. Engr., informs us that the bids for sections 1 to 4 were as follows:

Bids for Sections 1, 2, 3 and 4 of Sewer System, Malden, Mass.

Items.	J. N. Drew & Co.	National Con. & Co.	Metropolitan Const'n Co.	Joseph Long & Co.	Jas. Heath & Son.	A. W. Bryne.	Weaving, Booth & Co.	Fallon & Cronin.	Rich. Falvey.	R. D. Shanahan.	Lindsey & Cudmore.
Excav., 8 ft. deep, 24,242 cu. yds.	$0.10	$0.84	$0.70	$0.60	$0.49	$0.54	$0.78½	$0.74	$0.60	$0.60	$0.75
" 8 to 12 ft. deep, 6,451 cu. yds.	.30	1.50	1.15	.85	.70	.60	.78½	1.00	1.00	.70	.90
" 12 to 16 ft. deep, 310 cu. yds.	1.50	2.08	1.15	1.40	1.00	.65	.80	1.50	1.20	.80	1.00
18-in. pipe, laid, 2,704 lin. ft.	1.00	.25	.15	.18	.15	.15	.20	.35	.25	.10	.15
15 " " " 364 " "	1.00	.25	.10	.16	.12	.10	.18	.35	.20	.10	.10
12 " " " 2,505 " "	.90	.14	.08	.12	.10	.10	.15	.25	.15	.05	.08
10 " " " 6,284 " "	.85	.12	.08	.08	.08	.10	.15	.25	.10	.05	.05
8 " " " 14,574 " "	.65	.07	.08	.06	.06	.10	.13	.15	.10	.05	.05
Brick masonry, 548 cu. yds.	8.00	6.50	4.75	4.75	4.00	6.00	5.50	6.25	5.50	5.50	4.75
Concrete masonry, 40 cu. yds.	7.00	4.60	4.50	4.50	5.00	5.00	4.50	6.00	6.00	3.00	3.70
Lumber, 10,000 ft., B. M.	40.00	35.00	40.00	30.00	35.00	40.00	25.00	25.00	25.00	27.00	40.00
Paving, 266 sq. yds.	3.00	2.75	3.00	3.00	2.25	3.00	1.00	3.25	3.00	1.25	3.00
Total amounts	$30,824	$38,404	$31,037	$26,595	$22,122	$24,627	$31,871	$35,092	$28,881	$24,520	$29,932

PIPE.—Richmond, Va.—E. E. Davis, Secy. Com., writes us that the contract for pipe, noted last week, has been awarded to the Anniston Pipe & Foundry Co., at $19.00 per gross ton, the bid being $17.70 per net ton.

SEWER PIPE.—West Newton, Mass.—The contract for sewer pipe has been awarded to the Boston Building Material Co., at 75¼% discount from list price for regular pipe and 69¼% for extra heavy pipe, for the Knowles, Taylor & Anderson pipe. H. D. Wood, Cy. Engr.

BRICK.—Detroit, Mich.—The water board has awarded a contract for 500,000 hand-baled brick to the R. H. Hall Co., at $5.50 per M., delivered at the reservoir grounds.

Meriden, Conn.—A contract for 230,000 brick has been awarded by the sewer committee to the H. Wales Lines Co., at $8.50 per M.

CEDAR BLOCK PAVING.—Port Huron, Mich.—F. F. Rogers, Cy. Engr., informs us that the following bids were received for paving Pine Grove Ave. with cedar blocks, but that the board of estimates has disallowed the paving work: D. N. Runnels, $9,179; Hull & Carlisle, $8,776; Chas. Hill & Co., $8,576; W. F. Ernst, $8,468; Finane & Mertz, $8,410; J. De'oyea & Co., $8,249. The price of the lowest bid were as follows:

CEMENT.—Meriden, Conn.—A contract for 850 bbls. of cement has been awarded by the sewer committee to the H. Wales Lines Co., at $1.14½ per bbl.

West Newton, Mass.—H. D. Woods, Cy. Engr., informs us that a contract for American cement has been awarded to Waldo Bros., Boston, at $1 per bbl. for the Rocklock brand.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

CEMENT.—Pittsburg, Pa.—Bids are asked until April 14 for 2,000 bbls. of cement. Jas. A. Grier, county controller.

DRAINAGE.—Detroit, Mich.—The city engineer has prepared plans for draining Palmer Park and the park board has asked for an additional appropriation of $12,000 for this purpose. Senator Palmer is reported to have offered to construct a drain two miles long to convey the drainage from a half-mile beyond the park.

RACE TRACK.—Cincinnati, O.—A new racing association has been formed with a capital stock of $150,000, of which $44,000 was subscribed at the meeting of its promoters April 1. The new track will be located in Campbell county, Ky., across the river from Cincinnati. The members of the association include Horace E. Dunbar, J. W. Haley, Jacob Fecheimer, Elliot Marfeld and Marshall Halstead.

INDUSTRIAL NOTES.

SLEEPING CARS.—W. W. Webb, of Council Bluffs, Mo., is reported as organizing a company to build sleeping cars under his patents.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., is preparing to put in the switch, signal and interlocking plant on the Metropolitan Elevated Ry., Chicago.

THE BUDA FOUNDRY & MFG. CO., Harvey, Ill., has an order for 20 of its standard hand cars from an eastern railway, and reports that over 4,000 of its new steel wheels have been turned out in eight months.

T. A. HARNS & CO., of Chicago, have the contract for erecting 27 wooden bridges on the Cleveland, Lorain & Wheeling R. R., and are erecting several cable-way towers for contractors on the Chicago drainage canal.

THE HARVEY BOILER WORKS, Harvey, Ill., has the contract for a 20×50-ft. stand-pipe for the Auburn, Neb., water-works; also for a boiler and heater for the same works. The contractor for the entire plant is E. A. Rudiger, of Nebraska City, Neb.

THE AMERICAN WIRE GLASS MFG. CO., Chicago, has secured the contract for the skylights of the First Regiment Armory, comprising 75,000 sq. ft. This glass was described in Eng. News April 5, 1894. Francis T. West, 452 The Rookery, representative.

THE SECKNER CONTRACTING CO., Unity Building, Chicago, has been awarded the following contracts: water-works and sewerage systems at Park Ridge, Ill.; sewerage system at Winnetka, and a grain elevator for F. Marshall, this being the second elevator it has erected for him.

THE LOUIS K. COMSTOCK CO., Monadnock Block, Chicago, has been incorporated to carry on a general engineering and contracting business in designing and building electric railways, power plants, isolated lighting plants, etc. Pres. and Gen'l Mgr., L. K. Comstock; Vice-Pres., F. S. Richmond; Secy., J. R. Allen; Supt., J. H. Stahley.

THE VULCAN IRON WORKS CO., Toledo, O., has recently constructed a special steam shovel for excavating phosphate gravel for a Charleston, S. C., firm. The dipper has a capacity of 1¼ cu. yds., and swings 27 ft. high from the ground and 33 ft. each way from the center. The crane is 34 ft. high. The entire framework is of steel. A test load of two tons of pig iron in the dipper caused no deflection of any of the parts. This company is now using steel entirely in the construction of the frames of its most recent shovels.

THE YOUNGSTOWN BRIDGE CO., of Youngstown, O., reports work on hand as follows: For the B. & O. R. R., 9 spans of girders and trusses on the Midland Division; 4 girder spans for Franklin county, O., of from 75 to 80 ft., with steel joists; 4 large buildings for the Ohio Steel Co., of Youngstown, O.; some structural work for mining plant at Aspen, Colo.; a 75-ft. plate girder span for the P. & L. E. R. R.; and have just completed an 82-ft. double track plate girder span for the C., L. & N. R. R.; car barn for New Orleans, La., and 182-ft. plate girder draw for the Washington & Chesapeake Beach R. R.

THE WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., has an order from the West End Street Ry., of Boston, for 200 electric motors for open summer cars. The motors are of a new type just brought out, and are multipolar motors, having four pole pieces and four field coils. The armature is of the Gramme type, with a grooved surface, and the armature winding is done with machine wound coils, which fit into the grooves in the core. The method of suspension employed relieves the axle from the greater part of the direct weight of the motor, and consequently relieves the track from the hammering action. All side motion is guarded against when the car is passing over rough places in the track.

NEW COMPANIES.—Railway Wrecking & Salvage Co., Chicago, Ill.; $100,000; Joseph Kral and S. L. Winternitz.——Hicks Stock Car Co., Chicago, Ill.; $2,000,000; H. M. Heise, Archibald Gottell and James Mullen.——South St. Louis Stone & Contracting Co., St. Louis, Mo.; $2,000; Adam Geisel, Joseph Knaus and J. W. Allen.——Garden City Construction Co., Chicago, Ill.; $1,000,000; Lewis Boisoit, J. H. Clark and G. I. Barker.——G. H. Starke Dredging & Docking Co., Milwaukee, Wis.; $300,000; W. A. Starkie, A. F. Bues and C. Milderman.——City Gas Co., Philadelphia, Pa.; $5,000, commencing with $500; Treas., R. R. Taylor, 2129 Pine St., Philadelphia.——Johnson Co., Cleveland, O.; iron mining and steel manufacture; $5,000,000; Thomas L. Johnson, A. J. Moscham and Andrew Squire.

METAL MARKET PRICES.

LEAD.—New York: 3.4 to 3.5 cts. Chicago, 3.25 cts. St. Louis, 3.2 to 3.25 cts.

NAILS.—Pittsburg: $1 to $1.05 for wire and 95 cts. for cut at mill.

FOUNDRY AND PIG IRON.—New York: $12 to $13.50. Pittsburg: $10.50 to $11.50. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.4 cts.; spikes, 1.6 to 1.8 cts.; track bolts, 2 to 2.1 cts. with square and 2.2 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.4 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.3 to 2.4 cts. with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $12 for iron and $10 for steel; light rails, $24 to $26; girder rails, $24 to $25. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10 for iron and $8 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.3 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.15 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.4 cts. for shell, 1.55 to 1.6 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.15 to 1.25 cts.; channels, 1.15 to 1.25 cts.; angles, 1.1 to 1.2 cts.; tees, 1.25 to 1.35 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.1 to 1.2 cts. for tank, 1.3 to 1.4 cts. for shell, 1.5 to 1.6 cts. for flange, 1.75 to 4 cts. for firebox. Chicago: beams, 1.35 to 1.4 cts.; channels, 1.35 to 1.4 cts.; angles, 1.35 to 1.4 cts.; tees, 1.5 to 1.6 cts.; universal plates, 1.3 to 1.35 cts.; steel plates, 1.35 to 1.45 cts. for tank, 1.7 to 1.8 cts. for shell, 1.6 to 2.1 cts. for flange, 2 to 5 cts. for firebox.